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WOOD HEATING IN ENERGY EFFICIENT HOUSING FOR THE NEW TOWN OF PEAWANUCK ONTARIO

E938

WOOD HEATING

FOR THE
NEW TOWN OF

PEAWANUCK

Prepared for
THE WEENUSK BAND

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With a Contribution from
ENERGY MINES AND RESOURCES CANADA
R.C.D.P. PROJECT CN 722

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November, 1988

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92-05559/

WOOD HEATING FOR THE NEW TOWN OF PEAWANUCK

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WOOD HEATING
FOR THE
NEW TOWN OF PEAWANUCK

ENERGY MINES AND RESOURCES CANADA
RCDP PROJECT CN722

PREFACE

Canada's remote communities are quite unique. Differences in lifestyles, social and economic conditions as well as geography and climate set these communities apart from the rest of urban and rural Canada. They are also different in terms of energy needs and energy options.

Most of these communities which lie below the treeline rely on wood fuel for space heating. While wood harvesting is often a source of employment, for climatic reasons tree growth is very slow and wood use may not always be a sustainable option.

It is with this in mind that this study has been done for remote community residents and others involved in housing in these communities with funding from the Remote Community Demonstration Program (RCDP) of Energy, Mines and Resources Canada. It is hoped that this information will assist those interested in energy and cost savings as well as a more comfortable living environment.

Energy, Mines and Resources Canada established the Remote Community Demonstration Program to help remote communities and agencies responsible for their energy supply to identify more appropriate energy alternatives and energy conservation opportunities.

WOOD HEATING
FOR THE
NEW TOWN OF PEAWANUCK

ENERGY MINES AND RESOURCES CANADA
RCDP PROJECT CN722

1:0 INTRODUCTION.

The objective of this study was to investigate the options for heating the houses in the new town of Peawanuck, Ontario for the Weenusk Indian Band.

In a previous study, where all options for space heating were examined, it was determined that due to tradition and for economic reasons, the use of wood heating would be pursued. This study would therefore be used to determine the most appropriate wood stoves for use in Peawanuck, as well as other similar remote communities.

Early in the study it became obvious that the entire house as a heating system should be assessed, not simply the choice of woodstove.

This assessment, as well as the house design, and the system for fresh air ventilation are presented in this report. In addition, an alternative design developed specifically for wood heating, although not built in Peawanuck, is provided.

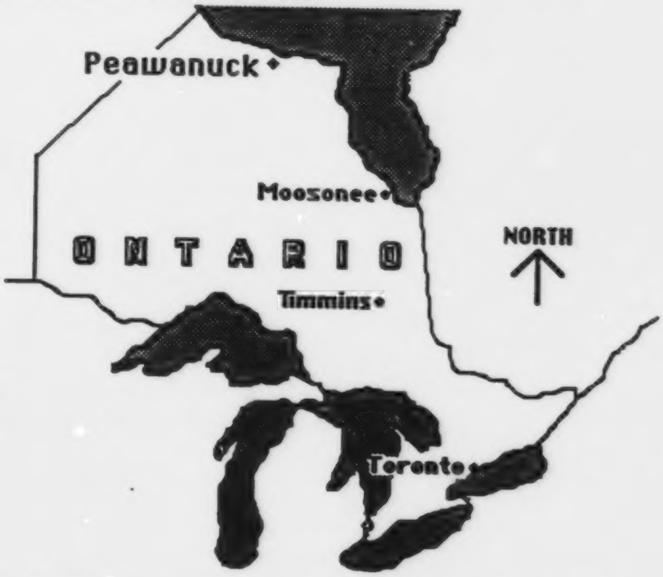
The stoves which were selected for study were installed in the new houses in Peawanuck and then monitored to determine the quality of heat output, wood fuel requirements, cooking capability, water heating capability, maintenance requirements, durability, ease of operation and the user's acceptance of the stoves.

During the monitoring, the occupants and other members of the Weenusk Band were introduced to energy conservation measures and a longer term program for maintenance was organized.

Finally, information transfer material was prepared so that the results of this study could be available to other remote communities and agencies responsible for remote energy supply and housing.

2:0 BACKGROUND:

The community of Peawanuck became a reality in May 1986 as the result of a disastrous spring breakup and flooding of the Winisk River which destroyed the former community of Winisk. Peawanuck, The Promised Land, was a community development concept which had been contemplated and planned for several years before the disaster, and was located some 18 kilometers upstream from the former townsite on an area of high ground overlooking the river. Emerging from an emergency tent settlement, it is now composed of 43 new houses, and several other institutional buildings, housing a population of 189. The construction of this new community was done by the Band members themselves with help from native construction workers from several nearby communities. Everyone lived on site in tents until the houses were completed enough for occupancy in November 1986 and were fully completed by January 1987. The Band members are now quite accomplished in the execution and management of construction projects and there is a background of experience as a result of the construction process which should lead to a well-developed maintenance program to ensure the safe and long term use of the new houses.



Peawanuck is located 36 kilometers upstream from the mouth of the Winisk River and Hudson Bay, 650 kilometers northwest of Moosonee. Access to Peawanuck is primarily by air via Moosonee or Pickle Lake to a gravel airstrip located near the community, although during construction all materials had to be lifted by helicopter from the old Winisk airport to the new site since the new airstrip had not been completed at that time. Regularly scheduled passenger and cargo flights are now available, and all supplies, including fuel, must come in by air.

The Weenusk Band members have now been living in their newly constructed houses for over one year, including 2 heating seasons, which included several weeks of -50° C weather. The houses and heating systems have therefore been put to the test.

At this moment, the Band looks to the future and the eventual completion of Peawanuck. To date, a Nursing Station, Police Station, Natural Resources office, maintenance garage and a storage garage have been completed. For the summer of 1988, plans are well advanced for the construction of a complete water and sewer system along with a new Church and community centre, and 10 more houses.

This study has been invaluable in providing input and direction in the design of the existing houses as well as the design of future housing.

Aerial View of the Townsite

Typical View of the Town of Peawanuck

3:0 PRELIMINARY INVESTIGATIONS INTO WOODSTOVES:

To begin the study, many persons who were experts in the use of wood heating were contacted and asked to provide information particular to the type of installation being contemplated in Peawanuck. As well, commonly available wood stoves and some that were not so common were considered.

A list of persons consulted is as follows:

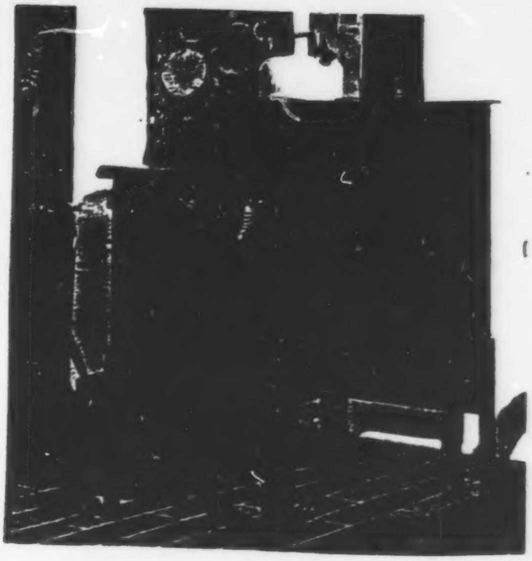
1. Cal Wallis	Wood 'n' Energy	McDonalds Corners
2. Craig Gutowski	Rainbow Energetiks	Woodbridge, Ont.
3. Tom Hendrick	Elmira Stoveworks	Elmira, Ont.
4. Jerry Carson	Heritage Stoves	Collingwood, Ont.
5. Charles Lemay	Consultant for Cree Housing	Ottawa, Ont.
6. John Guenin	Canadian Wood Energy Inst.	Don Mills, Ont.
7. Greg Allen	Allen Associates	Toronto, Ont.
8. Ted Kesik	Habitechnica	Toronto
9. Don Beugler	CMHC Research Division	Ottawa
10. John Gulland	Energy Pathways	Ottawa and Killaloe
11. Dan O'Leary	CMHC Proj. Impl'm'n Div.	Ottawa, Ont.
12. Rudolph Prell	Viesmann Mfg. Inc.	Waterloo, Ont.
13. Bob Topp	McDairmid Lumber	Winnipeg, Manitoba
14. Ron Walton	EMR, NWT Region	Yellowknife, NWT
15. Steve MacAleese	Air Heating Supplies	Downsview, Ont.
16. Victor Koby	Orilla Heating	Orillia, Ont.

A summary of the information provided by these consultants and wood stove manufacturers is presented as Appendix "A" to this report.

Based on the advice from these persons, the decision was made to install and monitor the following stoves for installation and monitoring in the houses in Peawanuck.

1. Selkirk Ranger
2. Heritage Cartier 1
3. Findlay Chatelaine
4. Lakewood Cottager
5. Hunter Valley Comfort
6. Elmira Sweetheart
7. Elmira Oval
8. Olsen Wood Furnace

Heritage Cartier



Selkirk Ranger

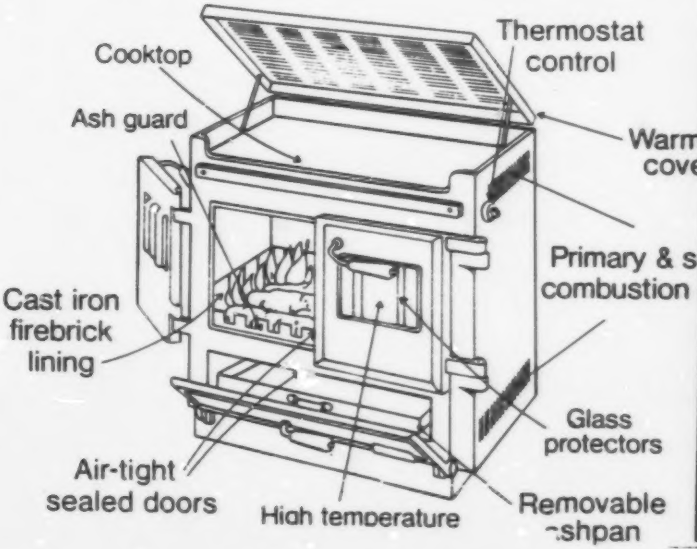
HERITAGE
energy systems

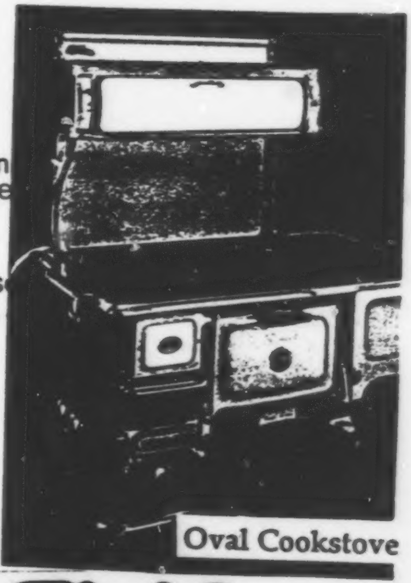
23 Balsam St. (Hwy. 26 W.) Collingwood,
Ontario L9Y 4H7 (705) 445-5650

SELKIRK METALBESTOS
130 North Augusta Road, Brockville, Ont., K6V 5V3

SELKIRK
METALBESTOS

PRINTED IN CANADA





Oval Cookstove

Findlay
Chatelaine

Elmira
Stove Works

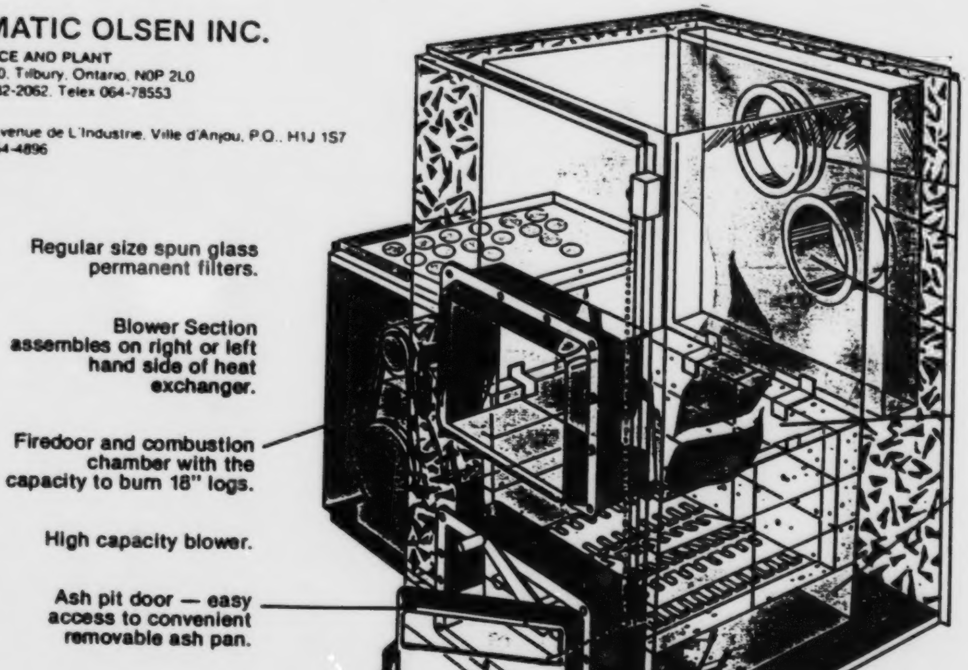
Elmira, Ontario, Canada N3B 1M3 519-669-5103
Printed in Canada

Woodstoves Installed in Peawanuck

Many stoves were considered other than those mentioned. These included the Scandanavian stoves such as Morso and Jotul, the American Vermont Castings stoves, The Pioneer Maid from Aylmer, Ontario, the Drolet 2000, Consolidated Dutch West, Fawcett CW66, Woodchief WC100C, and the Bell Industries furnace. Many of these stoves are of excellent quality and value; however, often due to cost they were eliminated. It was concluded that a simple, welded steel, airtight stove with the simplest kind of operating method would be the best. This caused many of the foreign stoves, which were more efficient but more complex and expensive, with potential maintenance problems, to be eliminated from further consideration.

However, it should be noted that based on this preliminary investigation, and due to time constraints, it was necessary to order stoves for all 43 houses early in the project, before any monitoring results were obtained. 22 Heritage Cartier stoves, 15 Selkirk Ranger stoves, one Olsen Wood Furnace (as shown below), and one or two of each of the other types were ordered. As well, the Teacherage had a wood-oil combination furnace and oil furnaces were used in the Band office and school which had the same floor area as the houses.

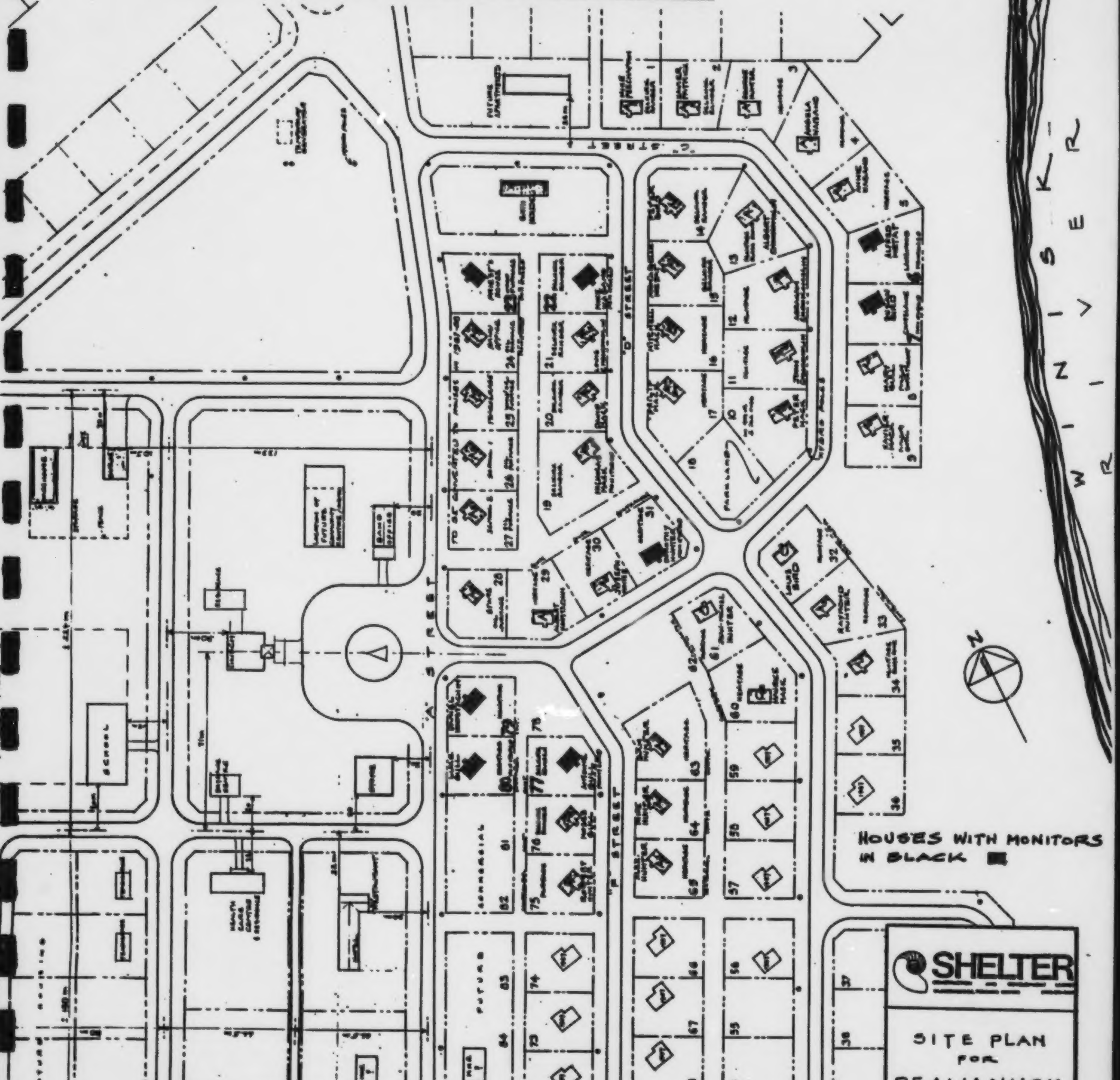
DUOMATIC OLSEN INC.
HEAD OFFICE AND PLANT
P.O. Box 900, Tilbury, Ontario, N0P 2L0
Tel (519) 682-2062, Telex 064-78553
QUEBEC
8200-8210 Avenue de L'Industrie, Ville d'Anjou, P.Q., H1J 1S7
Tel (514) 354-4896


Regular size spun glass permanent filters.
Blower Section assembles on right or left hand side of heat exchanger.
Firedoor and combustion chamber with the capacity to burn 18" logs.
High capacity blower.
Ash pit door — easy access to convenient removable ash pan.

This Duo-Matic Warm Air Furnace Burns Either Wood or Coal for Economy and Conservation

Olsen Wood Furnace

4:0 SITE PLAN SHOWING HOUSES AND STOVES



5:0 THE HOUSE

5:1 DESIGN OF THE HOUSE:

A study of the housing by Shelter Ltd. for the anticipated move of the Weenusk Band to Peawanuck was underway at the time of the disastrous flood in May 1986. As a result of this housing study and several quick preliminary design consultations with the Band in the weeks immediately after the flood, it was decided to build 3-bedroom detached houses, with basements if these could be afforded, and with energy-efficient designs using wood heating systems.

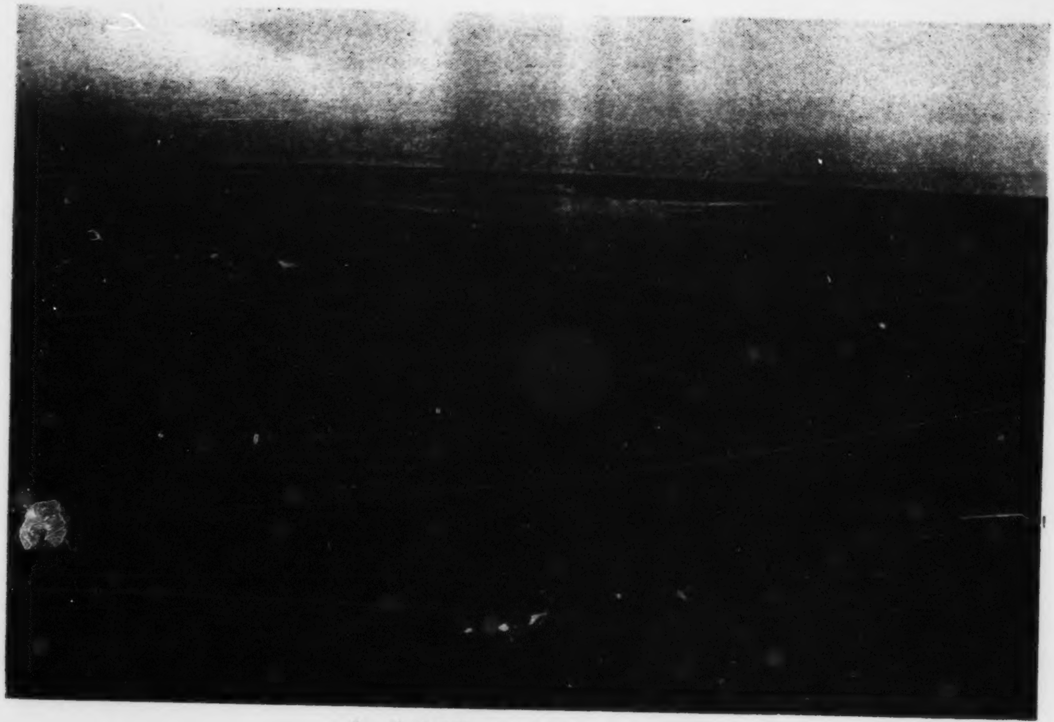
The construction work was to be carried out by the Band members.

The site of the new town of Peawanuck was 29 kilometers upstream from the existing town of Winisk and had no means of access. All the materials had to be flown to the Winisk airport, and then carried by helicopter to the actual jobsite. This of course caused the shipping cost to be very high, as it turned out about $44,000. per unit, of which over $20,000 was for the helicopters.

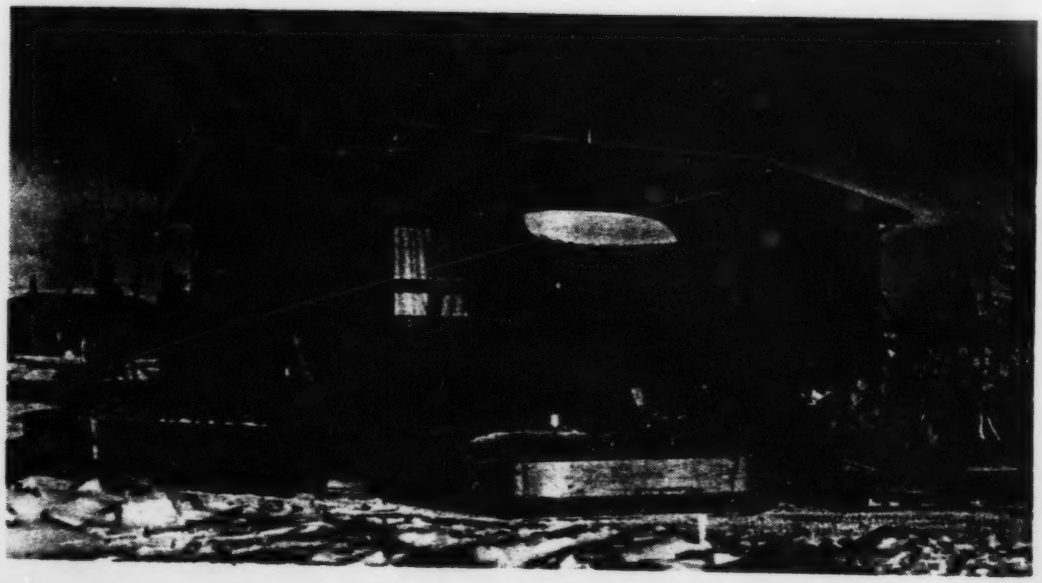
The basic idea in designing the house was to keep it relatively small and simple, therefore economical and easily constructed, and yet capable of providing comfort and energy efficiency to the optimum, most cost efficient level. From many design alternatives, 2 models were selected for refinement and construction.

The design, Model "A", has 3 bedrooms, a bathroom with an open kitchen - dining, living area. This open, multiple use of space increases liveability and the house "feels" much larger than its 24 x 36 (7.6m x 10.9m) dimensions. The floor area is 896 sq. ft. (83m2). (see plans in section 5:2)

Typical House in Peawanuck - South Side of Model "A"



Aerial View of the Townsite



Wood Supply Stacked Beside House

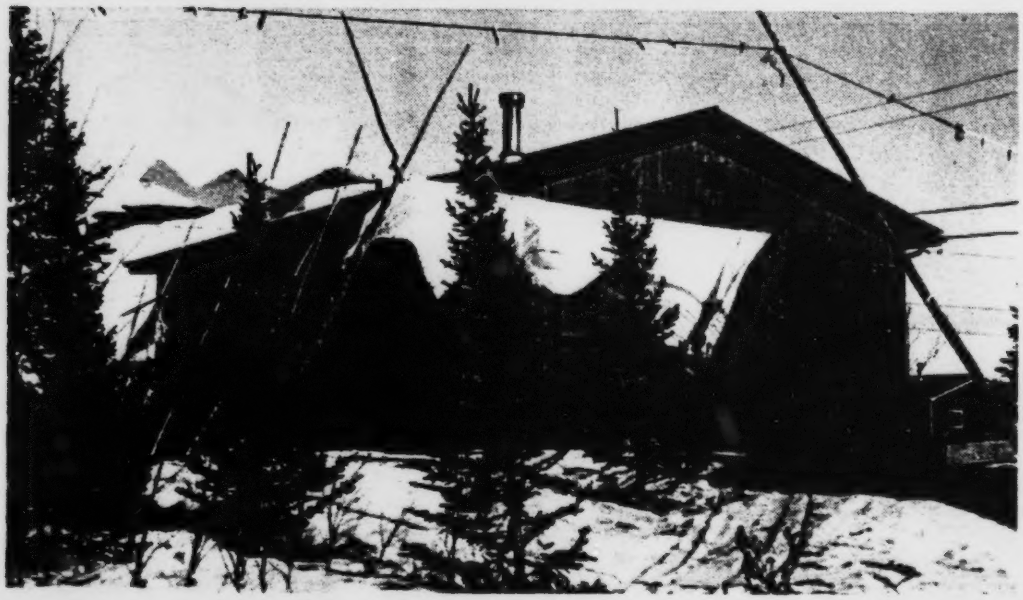
Wood is Gathered in Skidoo Sleds

The basement is also designed as useful space and can be used as heated work space and laundry and up to 3 extra bedrooms for larger families. Most of the windows, including the basement windows are on the south side of the house.

The kitchen and bathroom are back to back with the laundry directly below which minimizes the amount of plumbing.

The entry is through a windbreak vestibule onto a split level landing.

This split level entry creates a place for coats and boots separate from the main floor and it makes for easy access to the basement, thereby giving the basement more light and the feeling that it is part of the whole house. It is, by its nature a "dirty" area, and is most useful in keeping this dirt away from the clean main floor living areas. In a community with dirt roads, this transition entry area is an absolute necessity. This easy access is very useful for supplying wood to the basement and most importantly it causes cold air blowing into the house when the door is open, to drop down into the basement, thereby minimizing the effects of drafts on the main upper living areas.



North Side of the House - With No Windows

All the houses are designed so that most of the windows are on the south side, with no windows on the north.

Then on each of the lots, the houses were placed with a south facing orientation. This was not possible for lots on the south side of the east-west streets and therefore, on the 5 lots at this location, a different house model, known as "C" was designed, with identical exterior dimensions, but with a different plan, yet still south facing orientation. The "C" model entry is on the north (street) side of the house with the majority of the windows looking southward to the back yard.

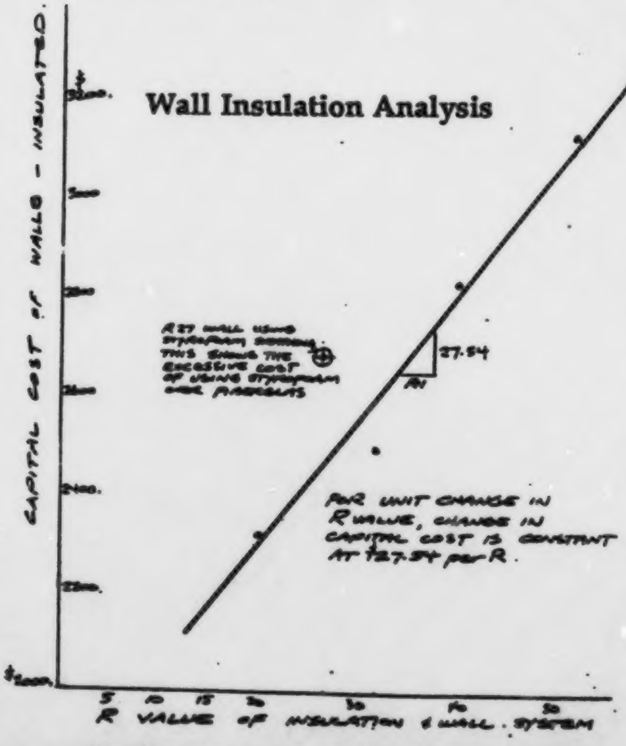
Actually, the ideal orientation is up to 15° or even 20° east of south in order to pick up the maximum solar gains. More morning sun is picked up to warm the house early in the day, and the late afternoon sun is reduced to cut down on overheating, which can be troublesome during the summer.

The ceiling and all the exterior walls including the basement walls are insulated to high, yet cost efficient levels. Although, due to time constraints a detailed insulation thickness analysis was not done for the Peawanuck houses, based on previous studies on similar houses for the northern Ontario region, fiberglas batt insulation was used to the following levels:

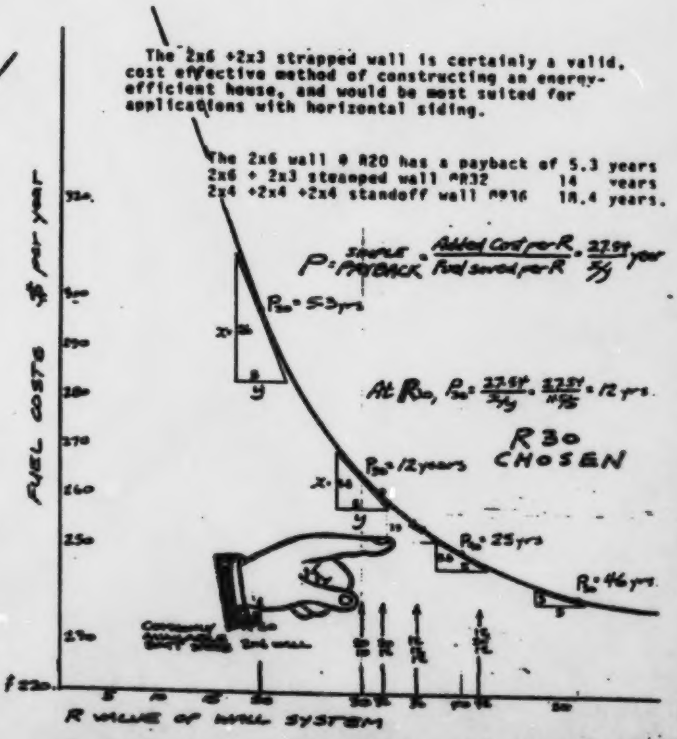
Ceiling	R40
Walls	R30
Basement Walls	R20

The graphs developed to determine the most cost-effective ceiling insulation levels are shown.

Wall Insulation Analysis



R vs Capital Cost of Wall



The 2x6 +2x3 strapped wall is certainly a valid, cost effective method of constructing an energy-efficient house, and would be most suited for applications with horizontal siding.

The 2x6 wall @ R20 has a payback of 5.3 years
2x6 + 2x3 steanped wall @R32 14 years
2x4 +2x4 +2x4 standoff wall @R36 18.4 years.

R vs Fuel Cost Per Year

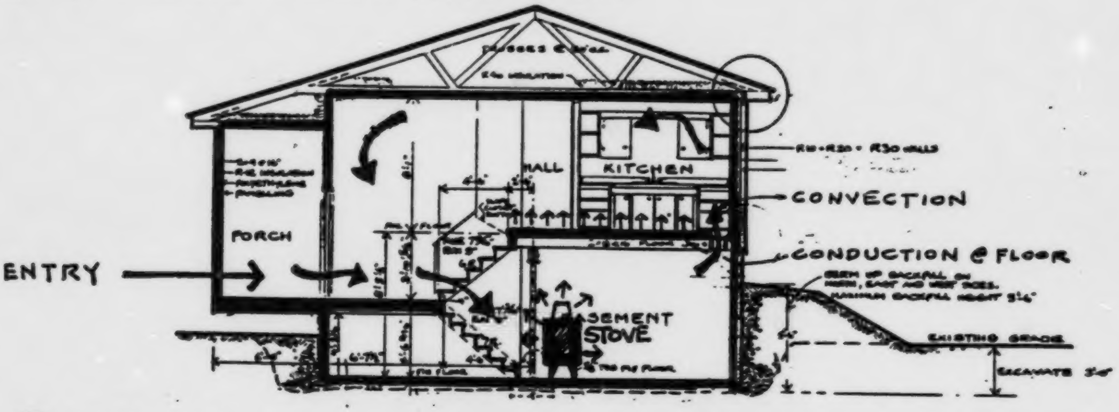
The house is sealed by careful installation of the polyethylene vapour barrier in the exterior walls and the wrapping of the outside of the house with Tyvek under the siding. The windows are all triple glazed prefinished sliders by Loewen Mfg. Inc. from Manitoba.

If a house is well sealed, there can be a potential problem with indoor air pollution, the build up of humidity which causes condensation and mould on walls and windows, and with the introduction of combustion air.

To alleviate these potential problems, a fresh air heat exchanger was built into each house, and is described in Section 5:4 of this report.

The house as a heating system can be thought of as the basement area being the hot air plenum for distribution of heat to the upper main floor.

The wood stove, centrally located, heats up the entire basement area and this heat is distributed in 2 ways. Firstly, it circulates upward by natural convection and enters the upper floor through 10" x 14" (250 x 356) damper grilles in the floor of each of the rooms above.



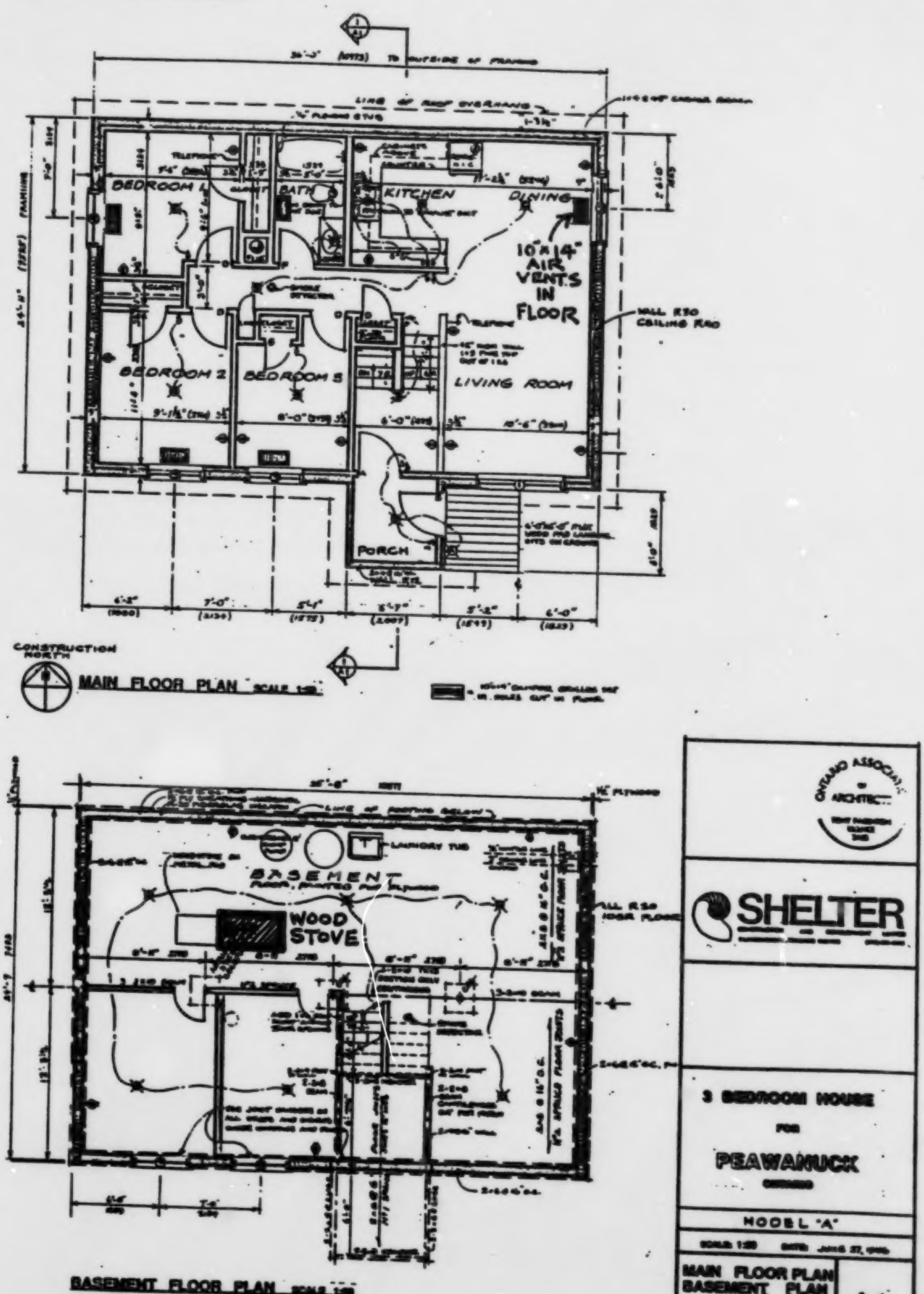
1/A1 CROSS SECTION

The cold air near the door at the landing will draft down into the basement, thereby setting up an air circulation pattern.

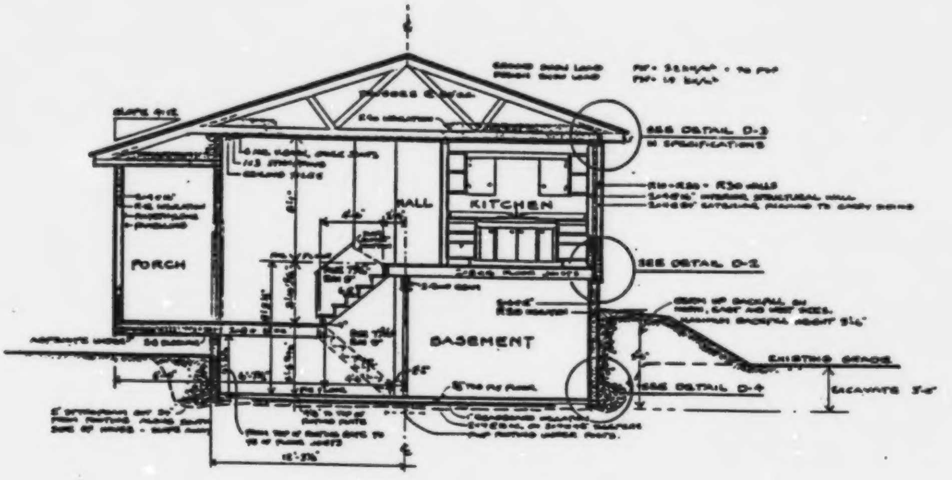
As well, the heat is radiated upwards directly through the floor membrane. This is noticeably effective and creates a warm very comfortable main floor. And because the building is so well sealed and well insulated, there are no noticeable drafts or stratification of air within the house.

The basement was designed using pressure treated wood walls and floor. R20 insulation was added in the walls and the thinnest possible layer of styrofoam insulation (R5) laid on the gravel under the floor. The wood stove would radiate heat directly into this large space.

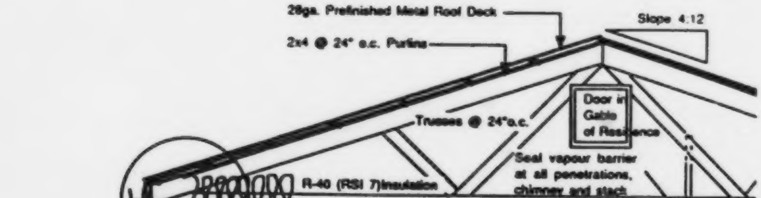
5:2 THE HOUSE PLANS



House Plan "A"

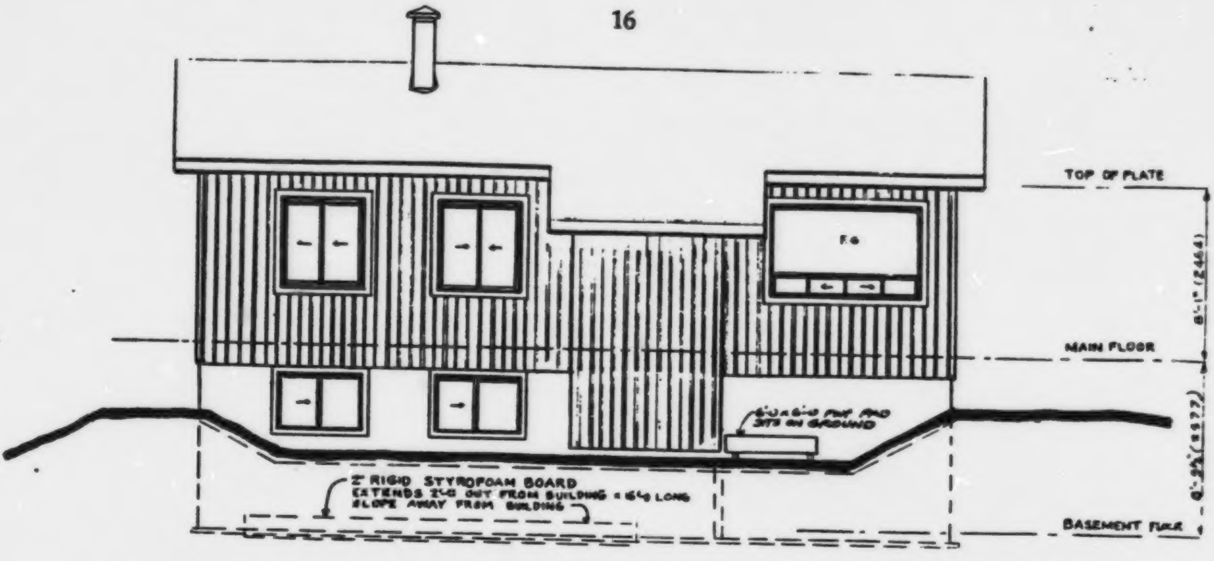


1/A1 CROSS SECTION

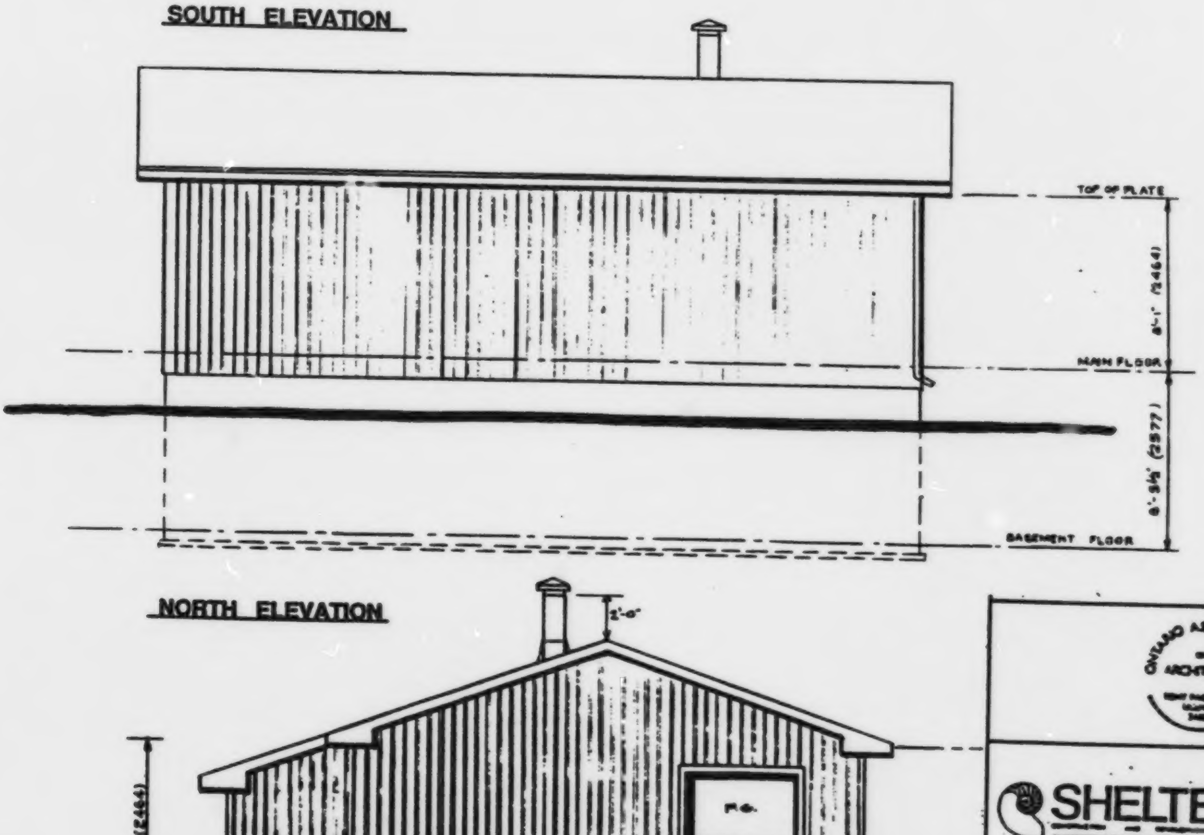

28ga. Prefinished Metal Roof Deck
2x4 @ 24" o.c. Purlins
Slope 4:12
Trusses @ 24"o.c.
Door in Gable of Residence
Seal vapour barrier at all penetrations, chimney and stack
R-40 (RSI 7)Insulation
See D-5
6 mil Polyethylene vapour barrier, Caulk all joints.
1x3 (19x38) Strapping
Ceiling Tiles in Residence;
Prefinished Hardboard Siding
Tyvek sheathing
R-20 Fiberglas Batt Insulation
6 mil Poly.Vapour Barrier
MAIN FLOOR
R-10 Fiberglas Batts
2x3 @ 16"Strapping; Panelling on Interior;
2x6 @ 16" Framing to Hold Exterior Siding
8'-2" (2489)
Wrap polyethylene around end of joists
Caulk poly to vapour barrier in walls
2x8 Blocking between joists,
5/8" T&G Plywood subfloor
See D-6
2x8 @ 16"
7 1/2"
Bridging at Mid-span
4-2x10 Beam
5-2X10 Health Stn
Slope 1:10 out 3'-0"
Slope 1:4
Panelling on Interior
4 mil Polyethylene vapour barrier Caulk all joints
R-20 fiberglas insulation
2x6 PWF studs @ 12" oc.
Studs are 93 "(2362) Long Precuts.
1/2" PWF sheathing,Face Grain runs horizontal.
Exterior Coating of Asphalt Emulsion
caulk joints
10 mil polyethylene on exterior
Caulk and Fold All Joints
Berm Up Backfill
Backfill 8'-0" Max.
Existing Grade
Excavate 3'-0"
BASEMENT
8'-1 1/2 " Wall Height
2476
8'-6 1/2 floor to Fl.
5/8 PWF Plywood floor
2x4 @ 16"oc PWF floor joists
2x4 PWF sleepers @ 4'-0"oc
4" Drain
Lead into sump
See D-2
1" Beadboard Insulation Under Floor to Within 24" of Edges.

CROSS SECTION

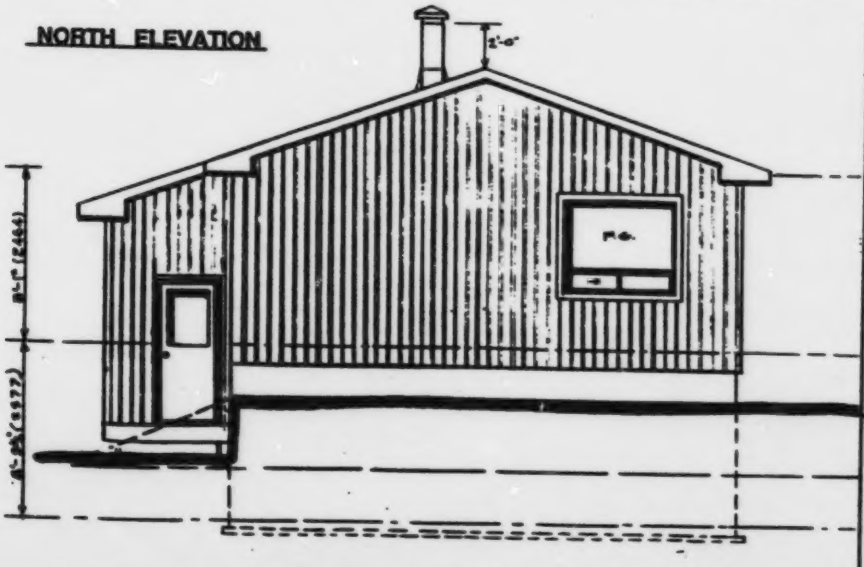
SHELTER
LTD.
R.R.3, CALEDON EAST, ONT.
L0N 1E0
(416) 880-1048



SOUTH ELEVATION



NORTH ELEVATION



EAST END ELEVATION

ONTARIO ASSOCIATION OF ARCHITECTS

SHELTER

3 BEDROOM HOUSE

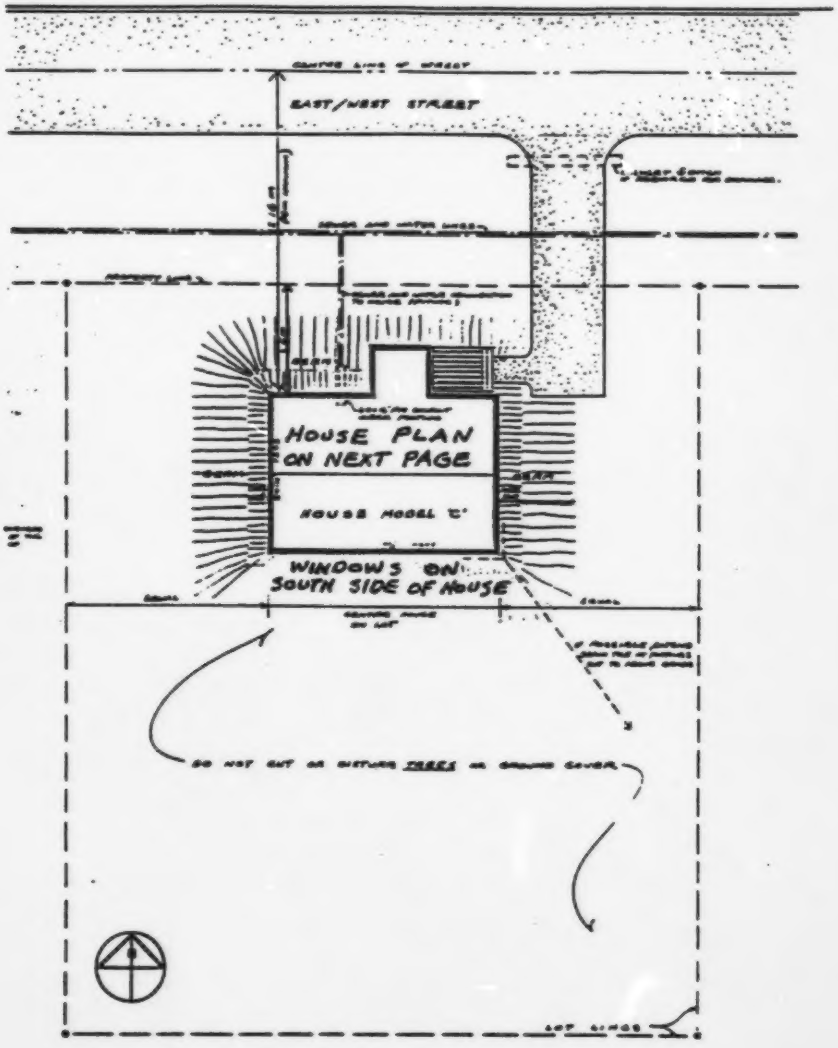
FOR

PEAWANUCK

ONTARIO

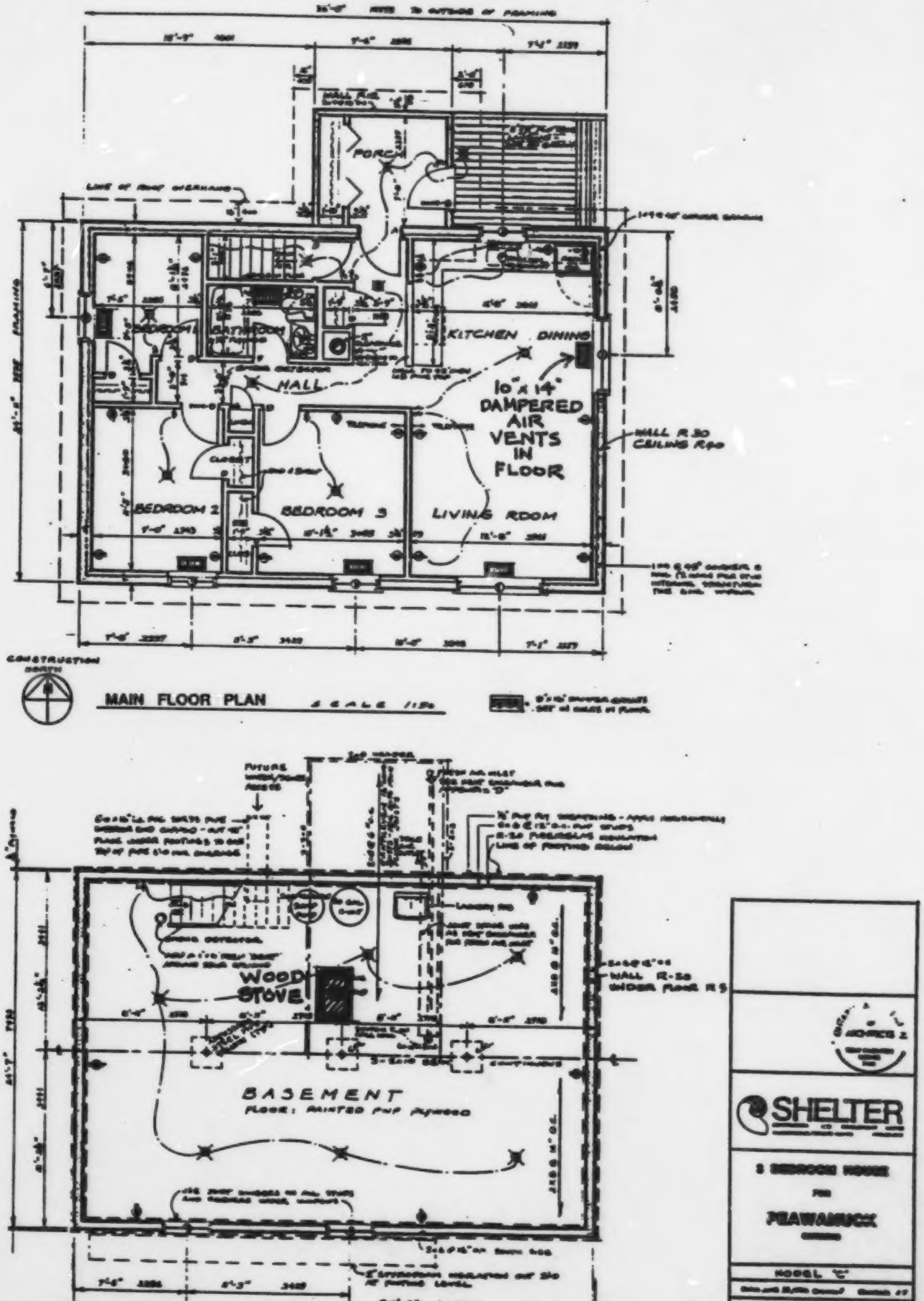
MODEL 'A'

SCALE: 1:50 DATE: JUNE 27, [illegible]



TYPICAL SITE PLAN SCALE 1:100
FOR HOUSE MODEL 'C'
THIS HOUSE IS DESIGNED FOR THE SOUTH SIDE OF AN EAST/WEST STREET

SITE PLAN



House Plan "C"

Designed for the South Side of an EAST-WEST Street

5.3 COST OF CONSTRUCTION

The cost of the house was originally targeted at $90,000, or roughly $30,000 each for materials, labour and shipping. In other words, a $60,000 house or $67 per sq. ft. ($6.20 per sq. metre) if built in Timmins or Thunder Bay. This amount was exceeded, but only because of the helicopter shipping costs.

In addition, the final budget included $7,500 for furniture and appliances since these were destroyed in the flooding of Winisk.

The total final cost, not including furniture or professional fees, was $105,418 per house as follows:

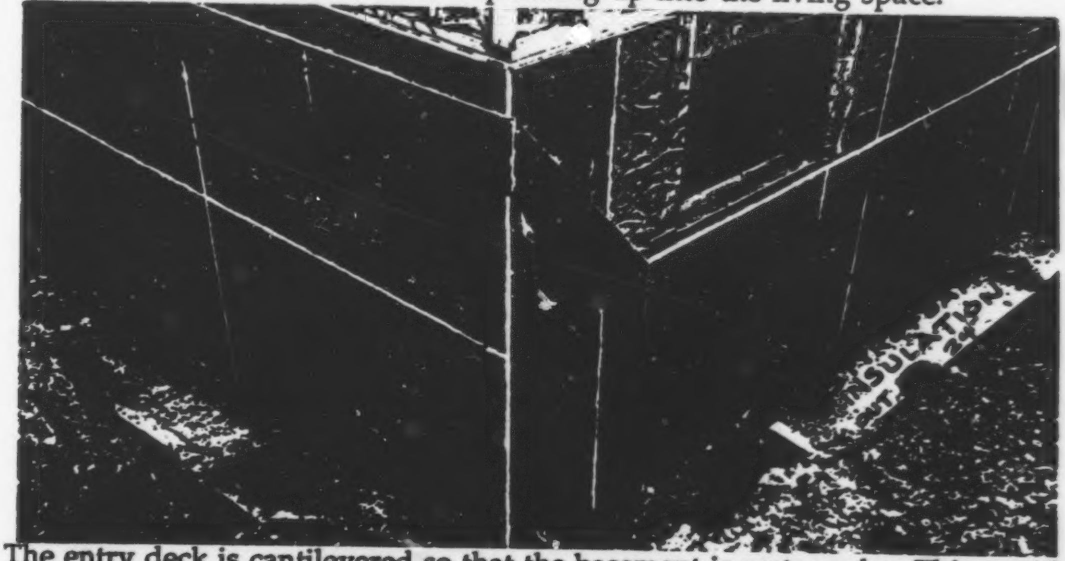
Material	$30,031.
Labour	30,690.
Air Freight shipping	23,382.
Helicopter shipping	20,605.
Landscaping	425.
Insurance	285.
	$105,418.

As a comparison, similar houses in Moosonee, much further south with no air freight component are being built by a contractor for $102,000 per unit which would indicate that the Peawanuck houses are very economical and efficiently built. The funding was arranged by means of a front and subsidy from Indian and Northern Affairs Canada supplemented with mortgage funding from a major bank as arranged by Canada Mortgage and Housing Corporation under the provision of Section 56-1 of the National Housing Act.

5.4 CONSTRUCTION DETAILS

The basement consists of conventional pressure treated wood using 2 x 6 @ 12" o.c. (38 x 140 @ 300 O.C.) structural studs with pressure treated plywood, coated and covered with 10 mil polyethylene sheathing. In northern isolated communities, this is the least expensive method of building a basement. The main advantage of having the basement is the structural integrity given to the house since the footings bear on frost free soil. Pier or strip foundations often have problems of differential settlement, are at least half as expensive as a full basement and provide no useable space.

The basement floor has 2 x 4 (38 x 89) sleepers covered with a painted plywood floor. There is a 6" (150) gravel base which is drained with 4" (100) weeping tile and a sump pump as insurance against water infiltration. The 1" (25) styrofoam insulation underneath ensures a very warm comfortable floor and inhibits ground moisture from evaporating up into the living space.

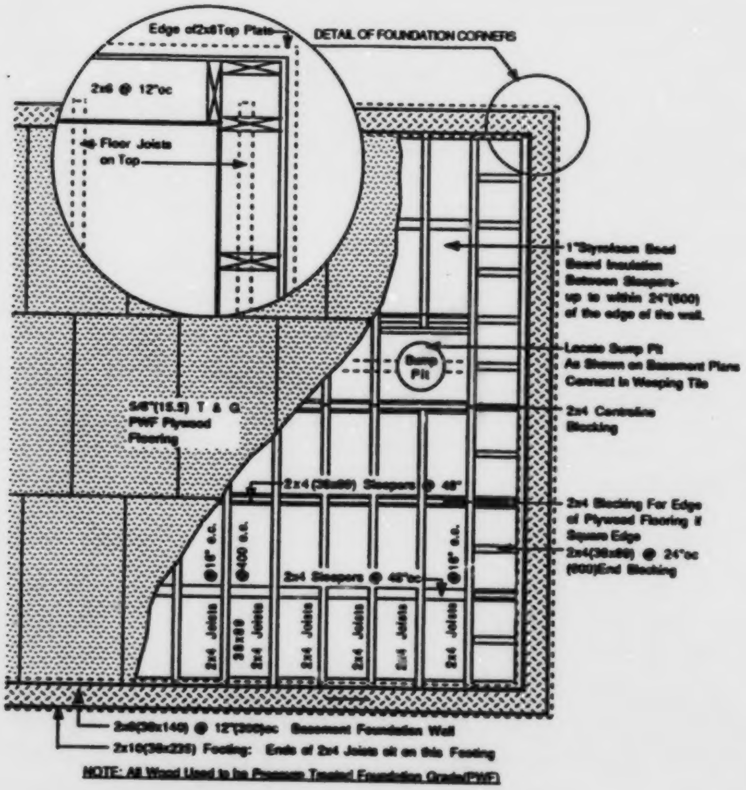


The entry deck is cantilevered so that the basement is rectangular. This avoids deck posts or foundation wall corners which are potential areas which the frost can grab, which distorts the building.

The basement is only excavated 3 feet (900) and the excavated earth is then bermed up against the north, east and west walls. The south wall is protected by extending a strip of 2" (50) styrofoam out 2 feet (600) all the way along.

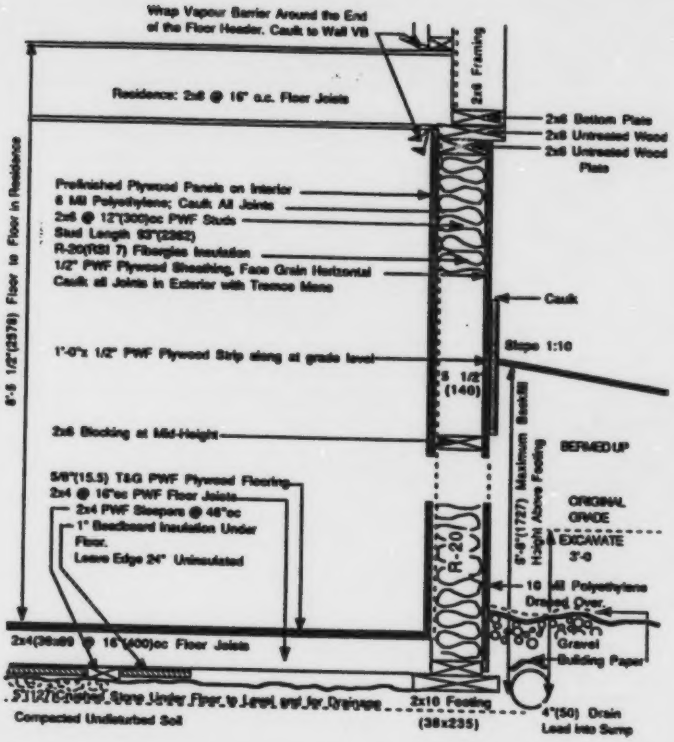
The main floor joints are locked into a notch in the double top plate of the basement wall so that R20 insulation and a continuous vapour barrier can pass outside the header. This eliminates the need to cut, fasten and caulk a section of vapour barrier between each floor joist. It is faster and does a better job.

Basement Wall Panel Under Construction

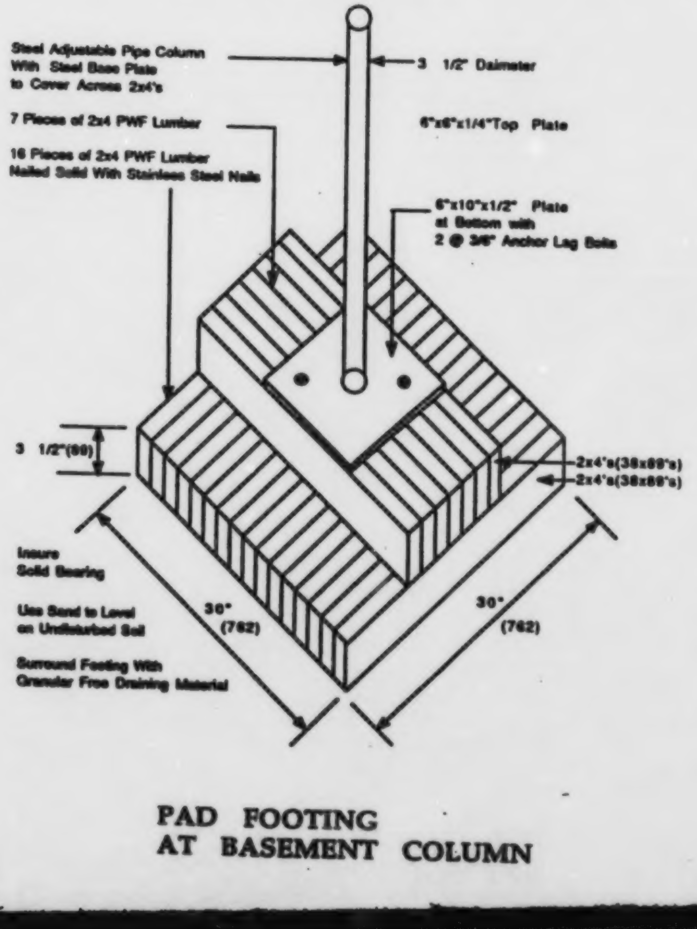


Edge of2x6Top Plate
DETAIL OF FOUNDATION CORNERS
2x6 @ 12"oc
Floor Joists on Top
1"Styrofoam Bead Board Insulation Between Sleepers- up to within 24"(600) of the edge of the wall.
Locate Sump Pit As Shown on Basement Plans Connect to Weeping Tile
Sump Pit
2x4 Centreline Blocking
5/8"(15.5) T & G PWF Plywood Flooring
2x4(38x89) Sleepers @ 48"
2x4 Blocking For Edge of Plywood Flooring if Square Edge
2x4(38x89) @ 24"oc (600)End Blocking
@16" o.c.
@400 o.c.
2x4 Sleepers @ 48"oc
@16" o.c.
2x4 Joists
38x89 2x4 Joists
2x4 Joists
2x4 Joists
2x4 Joists
2x4 Joists
2x6(38x140) @ 12"(300)oc Basement Foundation Wall
2x10(38x235) Footing: Ends of 2x4 Joists sit on this Footing
NOTE: All Wood Used to be Pressure Treated Foundation Grade(PWF)

BASEMENT FLOOR STRUCTURE


Wrap Vapour Barrier Around the End of the Floor Header. Caulk to Wall VB
Residence: 2x8 @ 16" o.c. Floor Joists
2x6 Framing
2x6 Bottom Plate
2x8 Untreated Wood
2x6 Untreated Wood Plate
8'-5 1/2"(2578) Floor to Floor in Residence
Prefinished Plywood Panels on Interior
6 Mil Polyethylene; Caulk All Joints
2x6 @ 12"(300)oc PWF Studs
Stud Length 93"(2362)
R-20(RSI 7) Fiberglas Insulation
1/2" PWF Plywood Sheathing, Face Grain Horizontal
Caulk all Joints in Exterior with Tremco Mono
Caulk
Slope 1:10
1'-0"x 1/2" PWF Plywood Strip along at grade level
5 1/2" (140)
2x6 Blocking at Mid-Height
5'-8"(1727) Maximum Backfill Height Above Footing
BERMED UP
ORIGINAL GRADE
EXCAVATE 3'-0
5/8"(15.5) T&G PWF Plywood Flooring
2x4 @ 16"oc PWF Floor Joists
2x4 PWF Sleepers @ 48"oc
1" Beadboard Insulation Under Floor.
Leave Edge 24" Uninsulated
R-20
10 Mil Polyethylene Draped Over.
Gravel
Building Paper
2x4(38x89) @ 16"(400)oc Floor Joists
5"(127) Crushed Stone Under Floor to Level and for Drainage
Compacted Undisturbed Soil
2x10 Footing (38x235)
4"(50) Drain Lead into Sump

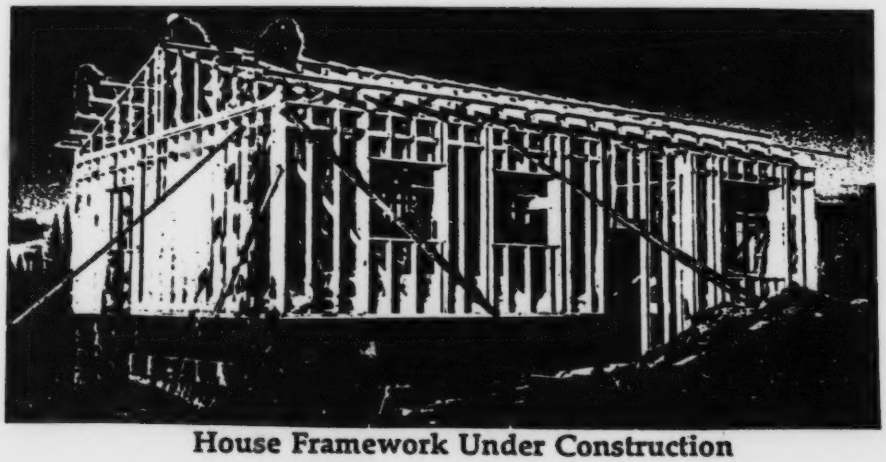
WALL SECTION AT BASEMENT


Steel Adjustable Pipe Column With Steel Base Plate to Cover Across 2x4's
3 1/2" Daimeter
7 Pieces of 2x4 PWF Lumber
6"x6"x1/4"Top Plate
16 Pieces of 2x4 PWF Lumber Nailed Solid With Stainless Steel Nails
6"x10"x1/2" Plate at Bottom with 2 @ 3/8" Anchor Lag Bolts
3 1/2"(89)
2x4's(38x89's)
2x4's(38x89's)
Insure Solid Bearing
Use Sand to Level on Undisturbed Soil
Surround Footing With Granular Free Draining Material
30" (762)
30" (762)

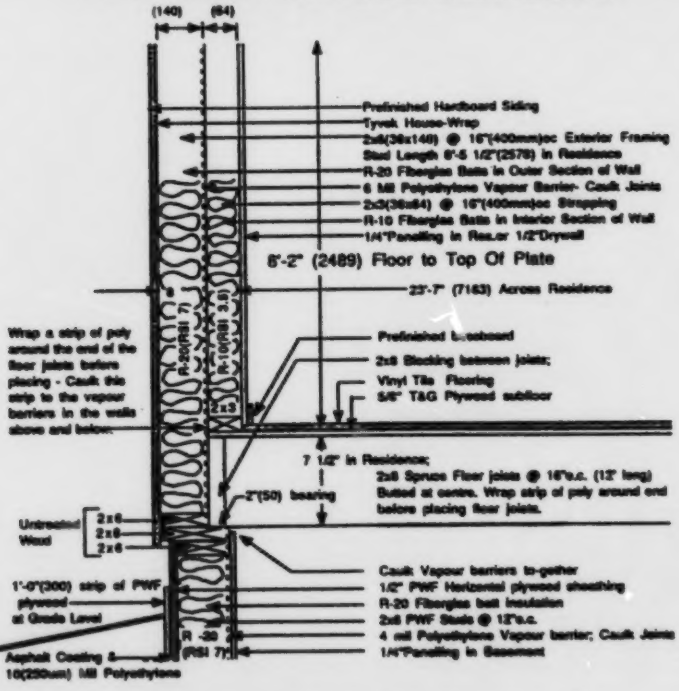
PAD FOOTING
AT BASEMENT COLUMN

The main walls are double 2 x 4 (38 x 89) stud walls erected to give space for the R20 and R10 insulation batts. The wall is 9" (228) thick and has no thermal bridge except at the plates. The vapour barrier is placed between the studs so that the interior 2 x 4 (38 x 89) wall is inside the vapour barrier. This ensures that there is no damage done to the vapour barrier before it is covered over. But the primary reason is to allow for the installation of electrical wiring, outlets and even plumbing in this inner 3 1/2" (89) space without penetrating the vapour barrier.

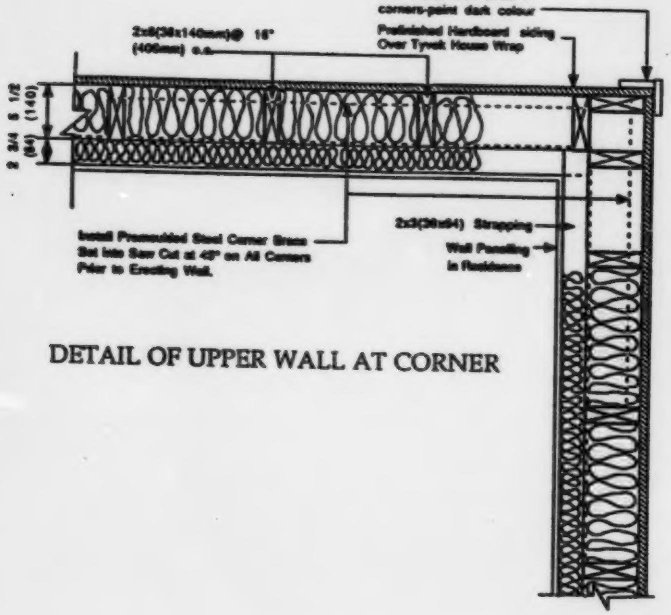
The outside of the house, after the R20 insulation has been placed, is wrapped in Tyvek and then covered with siding. Originally, it was planned to use locally cut wood boards but in order to save time, prefinished "Champlain" siding from MacMillan Bloedel was installed.



House Framework Under Construction


(140)
(64)
Prefinished Hardboard Siding
Tyvek House-Wrap
2x6(38x140) @ 16"(400mm)oc Exterior Framing
Stud Length 8'-5 1/2"(2578) in Residence
R-20 Fiberglas Batts in Outer Section of Wall
6 Mil Polyethylene Vapour Barrier- Caulk Joints
2x3(38x64) @ 16"(400mm)oc Strapping
R-10 Fiberglas Batts in Interior Section of Wall
1/4"Panelling in Res.or 1/2"Drywall
8'-2" (2489) Floor to Top Of Plate
23'-7" (7163) Across Residence
9
R-20(RSI 7)
R-10(RSI 3.5)
2x3
Wrap a strip of poly around the end of the floor joists before placing - Caulk this strip to the vapour barriers in the walls above and below.
Prefinished baseboard
2x8 Blocking between joists;
Vinyl Tile Flooring
5/8" T&G Plywood subfloor
7 1/2" in Residence;
2x8 Spruce Floor joists @ 16"o.c. (12' long) Butted at centre. Wrap strip of poly around end before placing floor joists.
2"(50) bearing
Untreated Wood
2x6
2x8
2x6
Caulk Vapour barriers to-gether
1'-0"(300) strip of PWF plywood at Grade Level
1/2" PWF Horizontal plywood sheathing
R-20 Fiberglas batt insulation
2x6 PWF Studs @ 12"o.c.
4 mil Polyethylene Vapour barrier; Caulk Joints
1/4"Panelling in Basement
R -20 (RSI 7)
Asphalt Coating &
10(250um) Mil Polyethylene

SIDE WALL SECTION AT FLOOR

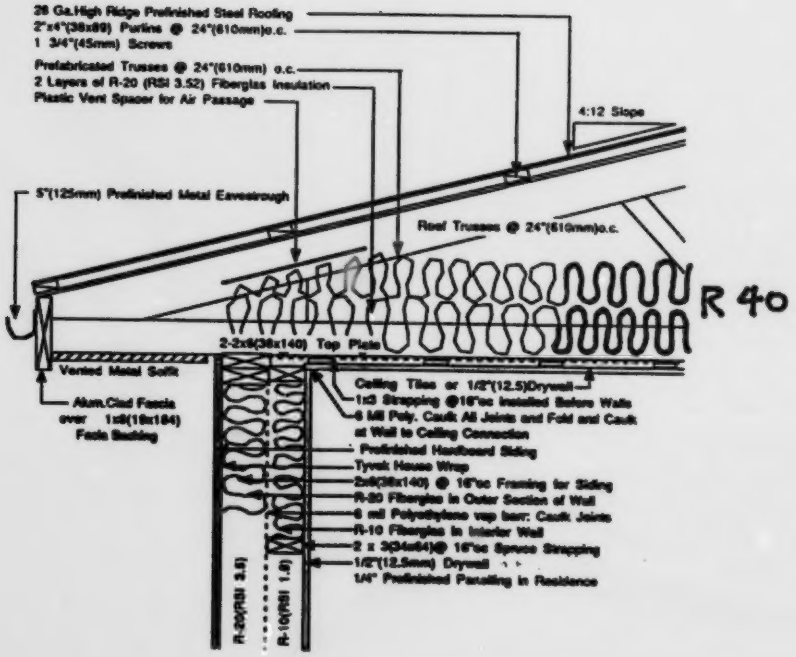


DETAIL OF UPPER WALL AT CORNER

Siding Installed Over Tyvek Housewrap

The roof structure was made of prefabricated trusses which spanned across the entire width of the building. This allows for a flexible interior partition layout and for the installation of the entire ceiling vapour barrier as one piece before interior walls were erected, thereby reducing potentially leaky joints and saving time.

The R40 ceiling insulation is placed on top of the ceiling between the roof trusses, and then penetrations by plumbing stack and flue are sealed. The attic space has a hatch only through the end gable and is vented by gable end vents and continuous soffit vents.


26 Ga.High Ridge Prefinished Steel Roofing
2"x4"(38x89) Purlins @ 24"(610mm)o.c.
1 3/4"(45mm) Screws
Prefabricated Trusses @ 24"(610mm) o.c.
2 Layers of R-20 (RSI 3.52) Fiberglas Insulation
Plastic Vent Spacer for Air Passage
4:12 Slope
5"(125mm) Prefinished Metal Eavestrough
Roof Trusses @ 24"(610mm)o.c.
R 40
2-2x6(38x140) Top Plate
Vented Metal Soffit
Alum.Clad Fascia over 1x8(19x184) Facia Backing
Ceiling Tiles or 1/2"(12.5)Drywall
1x3 Strapping @16"oc Installed Before Walls
6 Mil Poly. Caulk All Joints and Fold and Caulk at Wall to Ceiling Connection
Prefinished Hardboard Siding
Tyvek House Wrap
2x6(38x140) @ 16"oc Framing for Siding
R-20 Fiberglas in Outer Section of Wall
6 mil Polyethylene vap barr. Caulk Joints
R-10 Fiberglas in Interior Wall
2 x 3(34x64)@ 16"oc Spruce Strapping
1/2"(12.5mm) Drywall
1/4" Prefinished Panelling in Residence
R-20(RSI 3.5)
R-10(RSI 1.8)

SIDE WALL SECTION AT ROOF -

6:0 THE FRESH AIR HEAT EXCHANGER

A simple, site-built, fresh air heat exchanger was designed and was built by the local carpenters using simple methods.

Fresh air is drawn into the house through a 4" (100) pipe by means of an electric fan which is controlled by a dehumidistat mounted on a wall in the upper living area. This fresh air is distributed up into the bedroom closet of the master bedroom and also directly down over the woodstove through 4" x 10" (100 x 254) dampers.

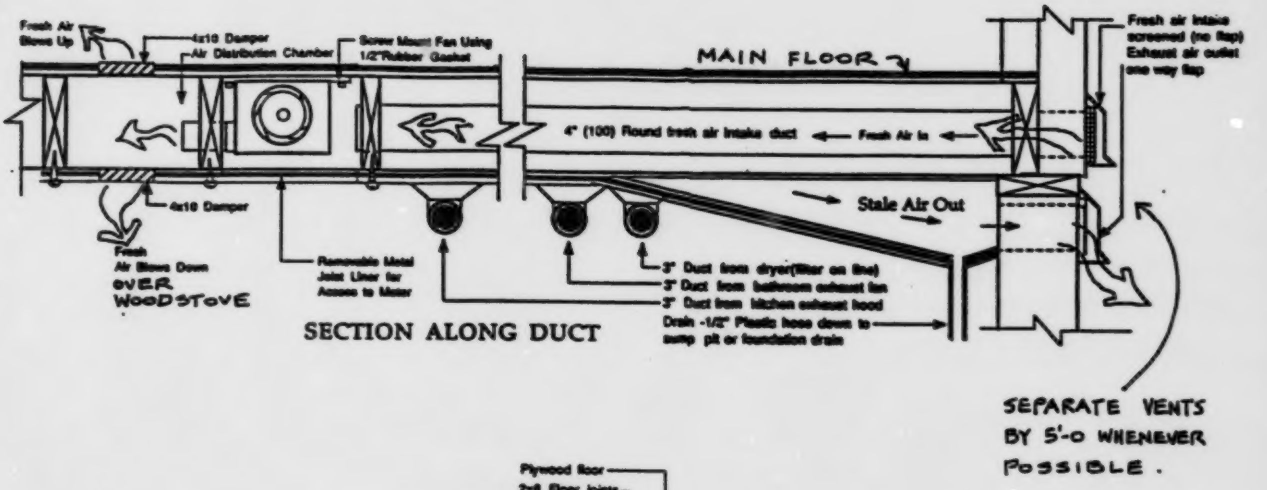
Since the fresh air is colder, it drops immediately and mixes with the hot air around the stove providing both fresh and combustion air to the house.

The dehumidistat control senses the humidity level in the house. The humidity builds up naturally due to normal human functions such as cooking, washing, and even breathing. Since the building is well sealed, at the dew point, this humid air will condense on cold surfaces, usually beginning with the windows. This humidity is proportionately related to any pollutants in the air and therefore if humidity can be controlled, generally this is a good indication that interior air quality is acceptable.

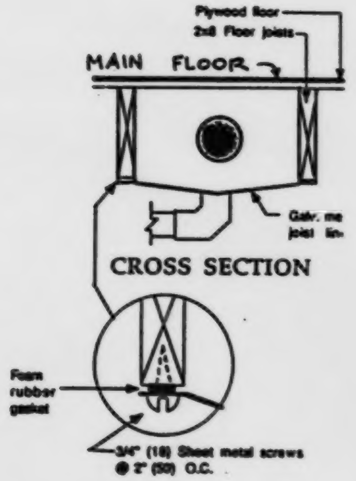
Fresh Air for Combustion
Dumps over Stove

Fresh Air
Heat Exchanger

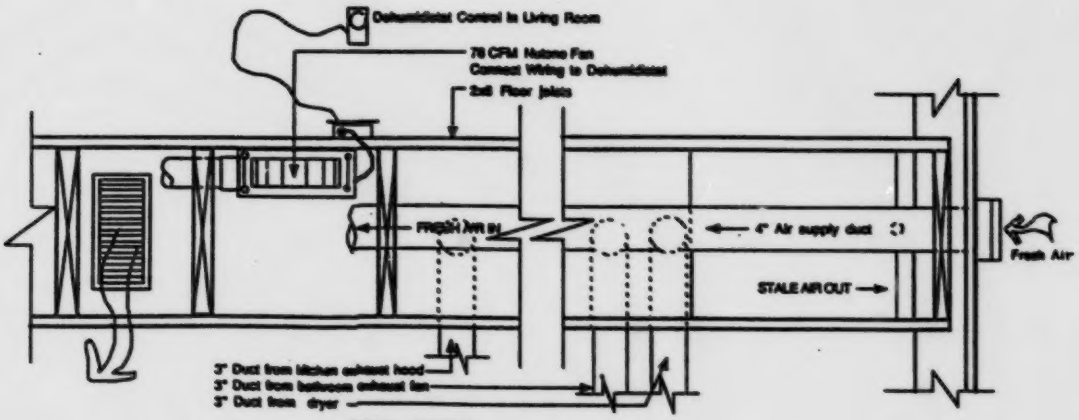
Heritage Stove


Fresh Air Blows Up
4x10 Damper
Air Distribution Chamber
Screw Mount Fan Using 1/2"Rubber Gasket
MAIN FLOOR
4" (100) Round fresh air intake duct ← Fresh Air In ←
Fresh air intake screened (no flap) Exhaust air outlet one way flap
4x10 Damper
Fresh Air Blows Down OVER WOODSTOVE
Removable Metal Joist Liner for Access to Motor
Stale Air Out
3" Duct from dryer(filter on line)
3" Duct from bathroom exhaust fan
3" Duct from kitchen exhaust hood
Drain -1/2" Plastic hose down to sump pit or foundation drain
SEPARATE VENTS BY 5'-0 WHENEVER POSSIBLE.

SECTION ALONG DUCT



CROSS SECTION


Dehumidistat Control in Living Room
78 CFM Nutone Fan Connect Wiring to Dehumidistat
2x8 Floor joists
FRESH AIR IN
← 4" Air supply duct
Fresh Air
STALE AIR OUT →
3" Duct from kitchen exhaust hood
3" Duct from bathroom exhaust fan
3" Duct from dryer

TOP VIEW

SHELTER
LTD.
R.R.#3, CALEDON EAST, ONT.
(416) 880-1048

FRESH AIR SUPPLY HEAT EXCHANGER

When the humidity rises above a level which can be preset by the occupant, the dehumidistat senses this humidity and starts the fan, which introduces the fresh, dryer air. It should be noted that the fan and intake pipe allow air to be pulled in past the fan chamber even when it is not running. This becomes a safety feature in case the fan is defective or shut off, because when the wood stove fire is lit, the exhaust gases rising up the flue create a negative pressure in the house which in turn draws air for combustion in past the fresh air fan. This feature also prevents stove backdrafting if all exhaust fans are on at the same time without the fresh air fan running.

The exhausting of stale air is done by means of a regular kitchen fan, bathroom fan, and if installed, the dryer exhaust fan.

Instead of running these exhausting devices directly outside, they are vented into the basement and over into an air chamber which surrounds the air intake pipe. This air chamber is one joist space which is created by fastening a metal joist liner to the bottom of 2 floor joists. It is large enough that it does not get clogged by frost and allows for some exchange of heat, thereby tempering the incoming cold air. This is a simple heat exchanger, and previous tests indicate that it is about 60% efficient. However it is very inexpensive, can be built by the client or contractor and serves 2 very necessary functions extremely well:it provides fresh air as required in an airtight house and prevents the exhaust device from leading directly outside, a cause of both excessive heat loss and operating problems. The efficiency can be improved by installing a more complex commercially available heat exchanger, but this is not as cost-effective a solution.
One of the main benefits of this system is the fresh smell in the house where people who live off the land are often cleaning, curing, and cooking game meats. As well, many homes dry their clothes during the winter in the basement, which would normally cause tremendous condensation problems and would in fact eventually destroy the building. These houses have little or no condensation on their windows and none was noticed or reported on any walls.

10"x14" Dampered Grilles in Floor for Air Circulation

7:0 CONSTRUCTION OF THE HOUSES

Even though some very preliminary studies were being undertaken, in May of 1986, when the disaster occurred, there had been no decision as to the building designs or even the preliminary design of the town plan of Peawanuck. Before the flood Peawanuck, "The Promised Land" had only been a dream for the Weenusk Band.

Within days, emergency measures were implemented to fast-track the decision-making and attempt to produce liveable buildings before the cold weather which begins in October and fully takes hold by November. This left 5 months. In the meantime, the people of Winisk built and lived in a "tent city" on the shores of the Winisk River, adjacent to the Peawanuck site.

Tent City

Fortunately, political recognition of the emergency nature of the project allowed funding to flow after a delay of only a few weeks.

Work in planning the town site and the houses was begun within 1 week by Shelter Ltd. and Marshall Maklin Monaghan Ltd., architectural and engineering consultants. The preliminary house designs were completed and approved by the Band within 1 week, and construction working drawings were completed along with a complete materials list within 2 more weeks. Competitive bids for materials were solicited from all suppliers who generally service the northern Ontario region.

At the same time, it was decided that the Band assisted by native workers from nearby communities would do as much of the work as possible within the November time deadline.

The decision was made, on the basis of the need to meet a November completion date, to build 30 of the 43 buildings using Band labour and 15 by employing an outside contractor. To this end, a request for bids was published and 8 tenders were received. The winning bidder was René Lefebvre Carpentry from Sudbury, and he was hired under a separate contract. Mr. Lefebvre's price was $94,316. per unit for everything, completely finished, except the helicopter portion of the shipping.

Thirty-seven of the housing were residences and 6 were adapted by varying interior partition layouts to be the Band office, Band store, 2 school classrooms, and residences for the teachers and the Priest.

Construction on site was begun by early July 1986. The Department of Defense flew in heavy equipment by Hercules aircraft to Winisk and then semi-dismantled, lifted by Chinook helicopter to the site where they were re-assembled.

At the same time, construction of a new airport was begun but this was not useable until after full freeze up in December.

One site supervisor, Eddie Lyonnais, was hired along with 4 assistants and these men organized the daily routine plus receiving, storage, and distribution of material.

Local workers and people from the surrounding communities made up the bulk of the workforce which varied in size up to 108 persons.

A work camp was built first with sleeping tents, and a tent for cooking, eating, and washing. Water was carried up from the river and electricity was produced using small portable 4000 watt generators. The activity was such that for a long period of time each meal had to be eaten in 3 shifts.

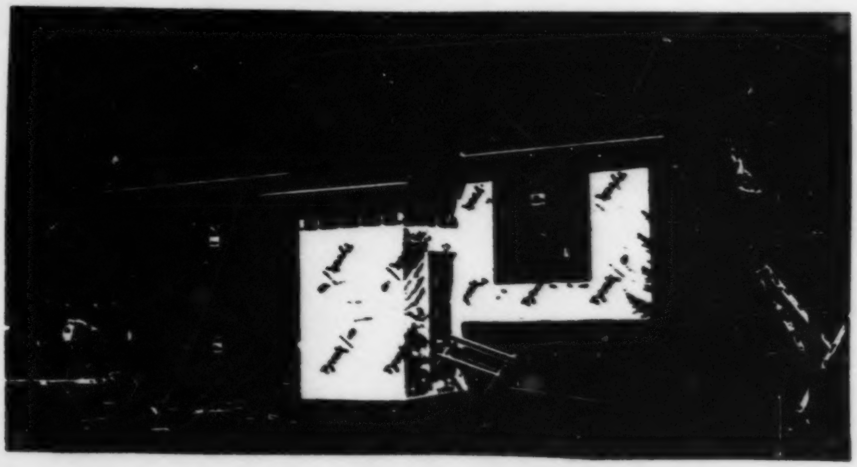
Work Camp

Fortunately, the Mennonite disaster relief organization volunteered their assistance and provided up to 7 persons for 2 week stints to help all summer long.

The workers were formed into crews who would learn how to fabricate one particular section of the building, for example, basement walls or roof trusses. They would do this chore on one house and then move on as if on a production line. This was done as a time saving device and was successful although near the end, the finishing was approached on a per house basis in order to instill a sense of pride and accomplishment once the house was completed.

Spacing of Houses on 100 foot wide Lots

By September 12th, all basements were installed and backfilled and 25 of the houses were framed up with roofs and siding. Seven of these were ready for the plumbers and electricians who arrived on September 15th.



Installation of the Siding

The delivery of material was from McDairmid Lumber from Winnipeg where all material was trucked to Pickle Lake, then flown by Austin Air Hawker Siddley 748 aircraft to the old Winisk airport. There they were unloaded by hand and stacked for airlift by helicopter using slings to the site at Peawanuck where materials were being used at such a rapid rate, storage was never a problem. It should be noted however that rarely was there a shortage of any items due to the coordination within the shipping system.

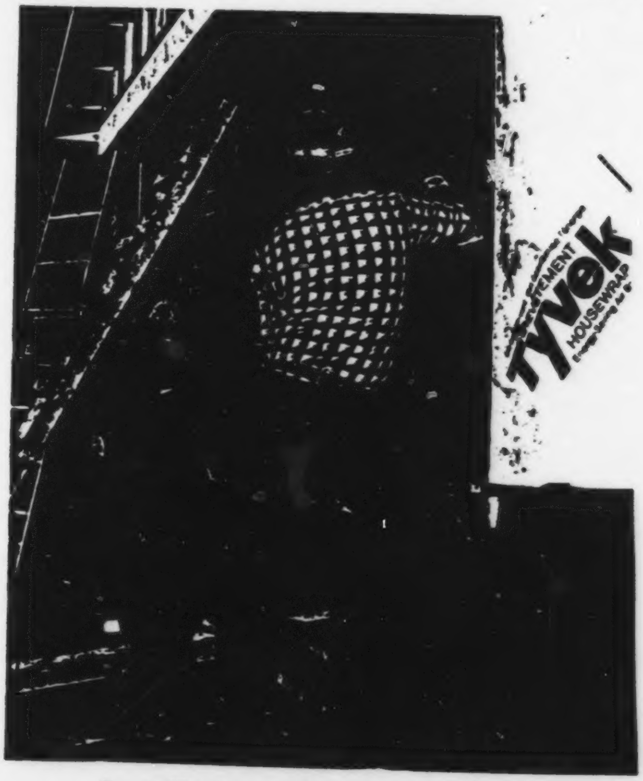
Delivery of Materials by Air and Helicopter

Transportation on site was by one pickup truck, one dump truck and several which drive all terrain vehicles used to pull 2 "farm type" wagons.

Distribution of Materials Around the Site by Wagon

All the houses were closed in by the end of October and in each house the basement was the first area to be finished. Since really cold weather had arrived, including a significant amount of snow, and all the Weenusk Band families, men, women and children, were still living in tents, it was decided that the families would move into the basements and live there while the rest of the interior of the upper floor was completed.

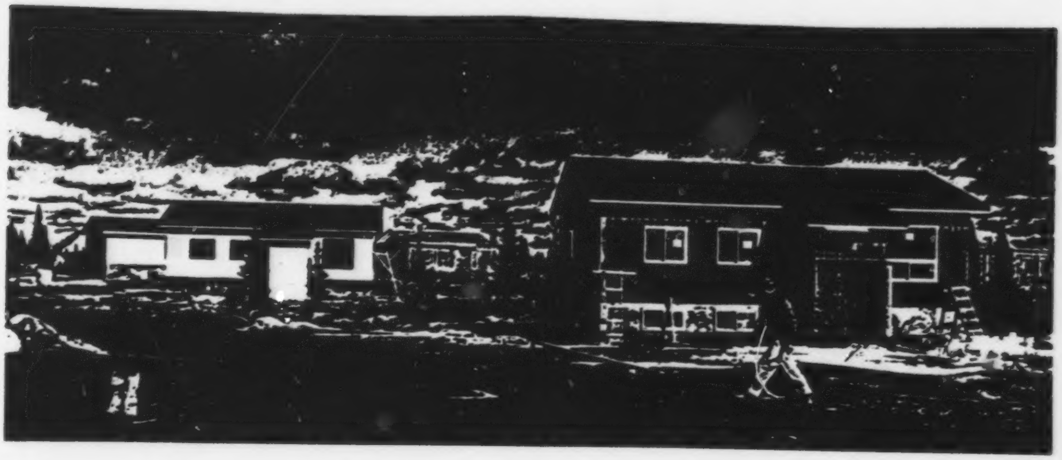
Interior before Partitions are Installed - Vapour Barrier Completed



Installation of Prefinished Siding

By this time, all the wood stoves had been delivered and were installed in all the houses.

The beginning of the test of the wood stove heating system was about to begin.



Distribution of Houses of 100 foot wide Lots

All the houses were completed including delivery of furniture before Christmas and the new community of Peawanuck was beginning to take its first breath as a cohesive entity.

Several houses were chosen for the installation of monitoring equipment for the scrutiny of the stoves and house as a heating system.

Data was originally collected in 10 houses, which were later reduced to 7, and this information forms the basis of the Monitoring section of this report.

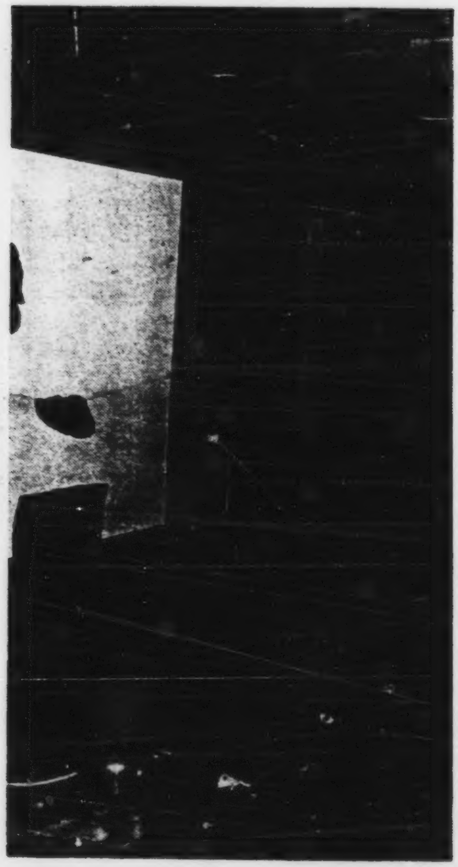
8:0 THE WOODSTOVES

8:1 ORDERING AND SHIPPING THE STOVES:

Prices for supply of the woodstoves were requested from several suppliers and, based on the cost, the stoves were ordered from McDairmid Lumber in Winnipeg, Manitoba and from Rainbow Energetiks in Woodbridge, Ontario. The stoves and accessories were shipped by truck to Pickle Lake, Ontario, then flown by Austin Airways to the old Winisk airport and then, as with the rest of the building materials, were transferred to the construction site by Huisson Helicopters. There they were distributed to each house by wagons pulled by 4 wheel drive Hondas and carried into each basement.

The shipping was expensive and complex and in a remote community such as Peawanuck, the weight and method of packing the stove becomes a factor worth considering. Several of the more complex stoves had protruding parts which were broken or missing; in fact, one entire stove was missing.

Heritage Cartier stove



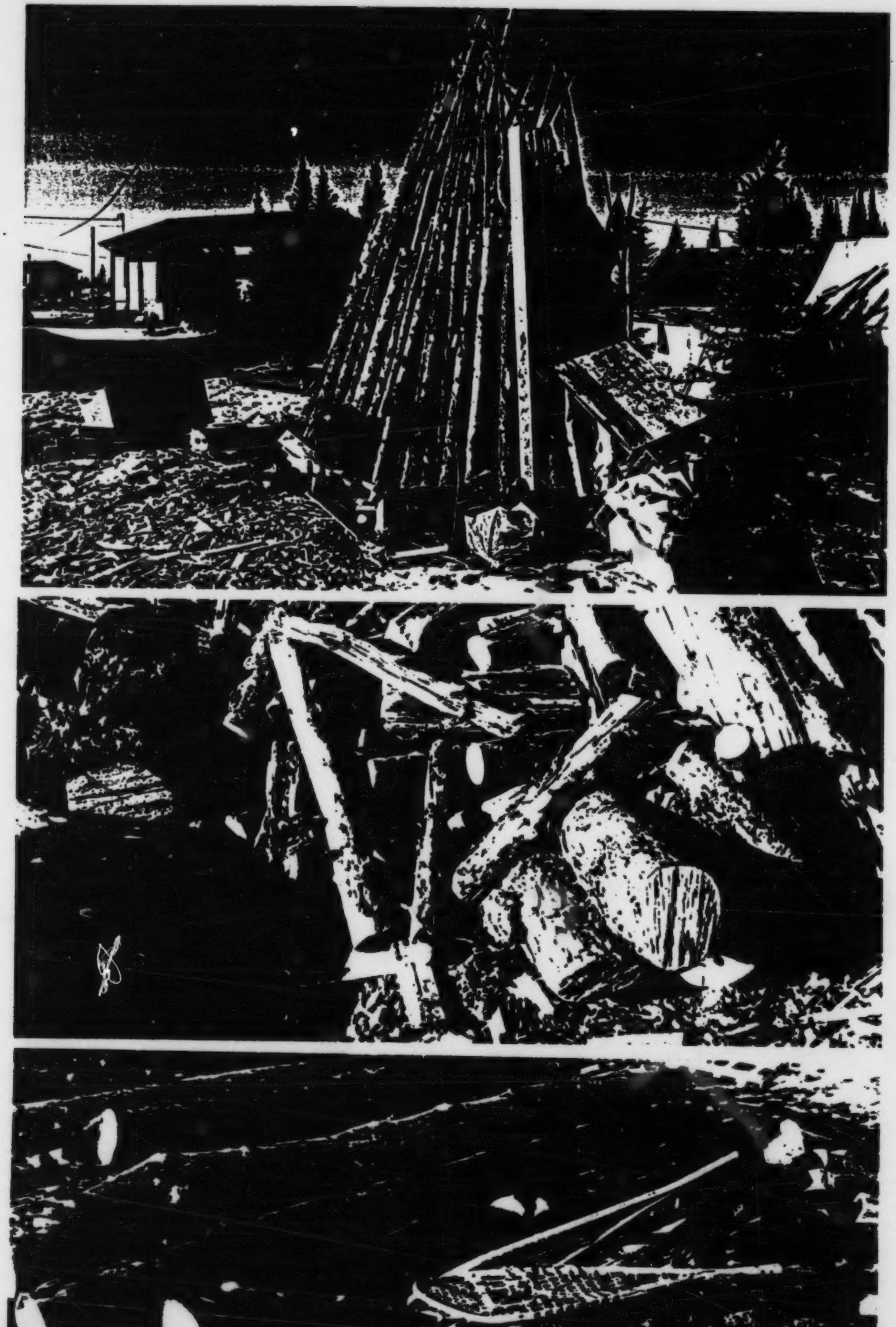
Lakewood Cottager Stove

8:2 INSTALLATION OF THE WOODSTOVES:

J. Jenkins went up to Peawanuck to organize the installation of the stoves when they arrived, and again from December 7th to 9th 1986 to inspect the installations. As a result of this inspection, various modifications were made and new stove boards (underlays) were ordered. Arrangements were made for a person from the Weenusk Band to do the on-site monitoring. Mr.Dominik Hunter was hired to do this work. Chief George Hunter and the Band Council informed the people of Peawanuck of the project and arranged that we could do the monitoring in whichever houses we chose.

The site plan of Peawanuck in Section 4:0 indicates the type of stove installed in each house, as well as the name of the occupant and the house type.

Dorothy Hunter's House with Winter's Supply of Wood



Wood Supply; Northern Black Spruce

9:0 MONITORING:

Monitoring consisted of measuring the wood consumption, indoor and outdoor temperature and humidity and air quality using carbon monoxide sensors. Air leakage was monitored using smoke pencils. Two monitoring periods were used due to only partially successful results on the first attempt. The monitors were looked after continuously by local persons and the consultants who visited Peawanuck every month to gather data and carry out visual inspections.

9:1 THE FIRST MONITORING ATTEMPT - March 1987

On March 2, 1987, Jeremy Jenkins, Charles Lemay, the wood stove consultant, and Bill Peden (EMR) went up to Peawanuck to install the monitoring equipment and to insect the installations which had then been in operation for 4 months. The hygrothermographs, which were supplied by EMR, had arrived by air from Ottawa that day.

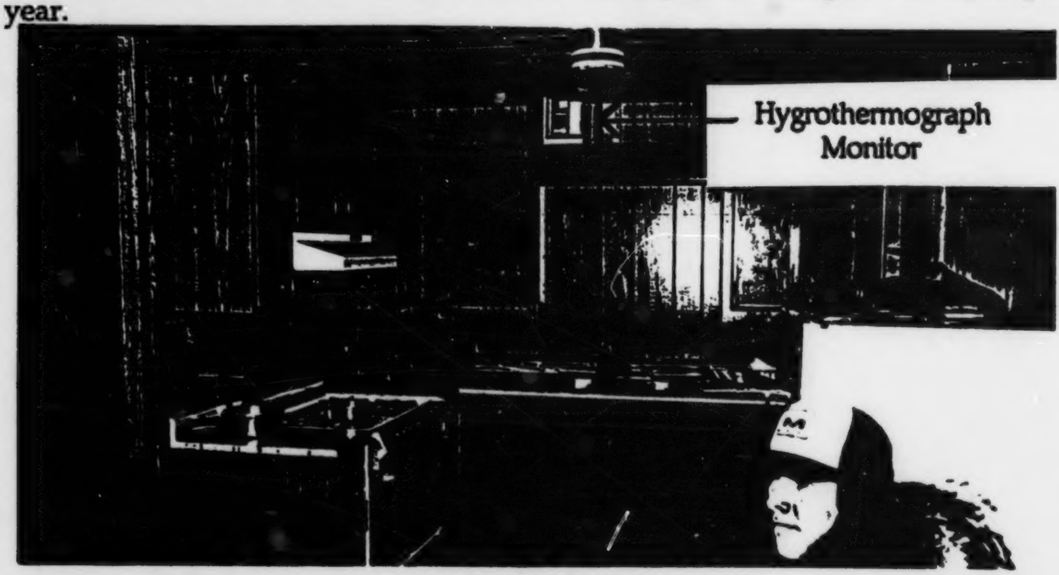
The monitors were set up in the houses as follows:

UNIT	OCCUPANT	STOVE TYPE
House #6	Alfred Metat	Lakewood Cottager
House #7	Susan Bird	Chatelaine
House 19	Nicholas Mack	Selkirk Ranger
House 22	Mike Wabano	Selkirk Ranger
House 23	Priest's House	Olsen Wood Furnace
House 24	Band Office	Olsen Oil Furnace
House 31	Dorothy Hunter	Heritage Cartier-1
House 77	Antoine Gull	Selkirk Ranger
House 80	Luke Gull	Heritage Cartier-1

These houses include a house using the wood furnace and a house being used as the Band Office with an oil furnace. The wood furnace had good reviews from the occupants and was felt to be a viable alternative. The oil furnace was chosen for comparative reasons since the building is identical in size to the houses. Note that all the houses in Peawanuck are exactly the same floor area, although there are some differences in floor plan layout and orientation which could make a difference in comparative monitoring.

A member of the Peawanuck community was to take care of the hygrothermographs which were set up with 30 day graph paper. He was to weigh all the wood used in each of the houses being monitored as well as to inspect the installations and report on any abnormalities. Unfortunately, he did not do the weighing of the wood consistently, and therefore the exact amount of wood used in each house was not known.

In the interviews with the occupants, several people claimed that they used about the same amount of wood in a week in these new houses as they used in a day in their old houses, while others claimed it was only about 1/4 of the amount used previously. In any case, it was significantly less. On average, the wood consumption for the entire heating season was between 2 and 3 cords (7 to 10 cubic metres) per house. This can be compared to between 10 and 14 cords per house in old Winisk and also can be compared to the study in Attawopiskat, where consumption averaged 12.2 cords per year, and in several James Bay communities where consumption averaged 9.5 cords per year.

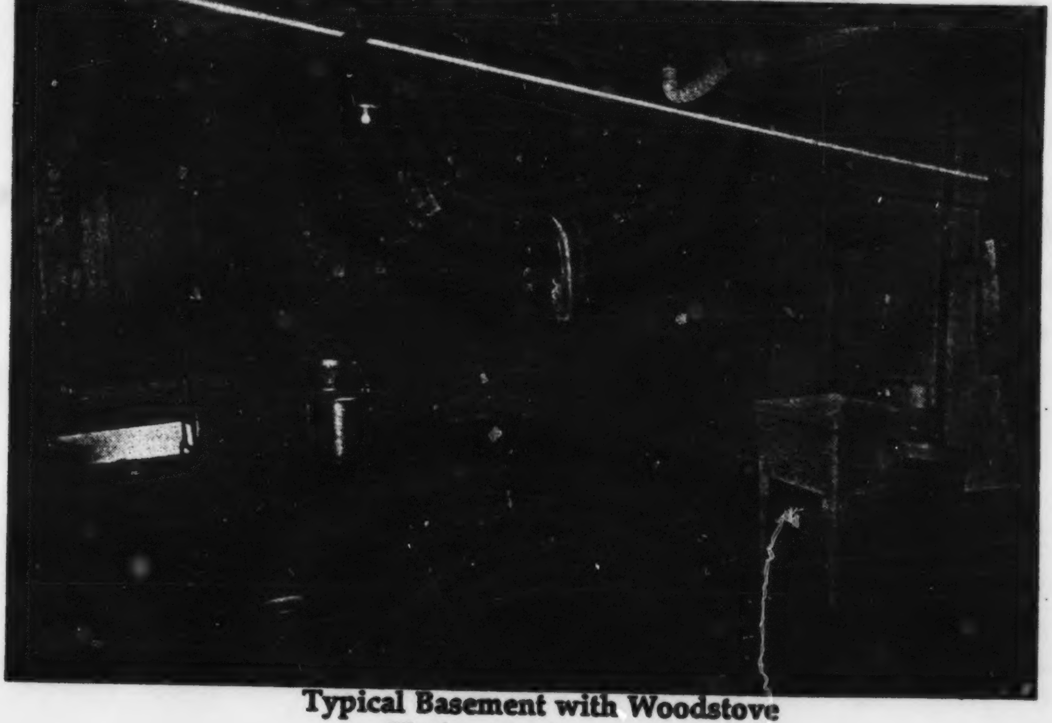


Kitchen Area

Wood is Gathered in Sleds Behind Skidoos

All stoves were lit in the morning and then burned on this one load of wood throughout the day. A few families with kids added a log just before lunch. Then some people reloaded the stove around 5 or 6 o'clock and this was all for the night. Other people never reloaded the stove, but relied on the one fire for the whole day's heat. Everyone was delighted with the way the houses stayed so warm and the ease with which the stoves were able to be kept fired. The uniformity of heat throughout the whole house was a notable feature in all the houses.

Hot water was heated in large pots on top of the stoves and this may have contributed to the storage of heat over extended periods of time.



Typical Basement with Woodstove
Clothes Drying on Line
Fresh Air Dumps Down over Stove
Water Pots Heating on Stove

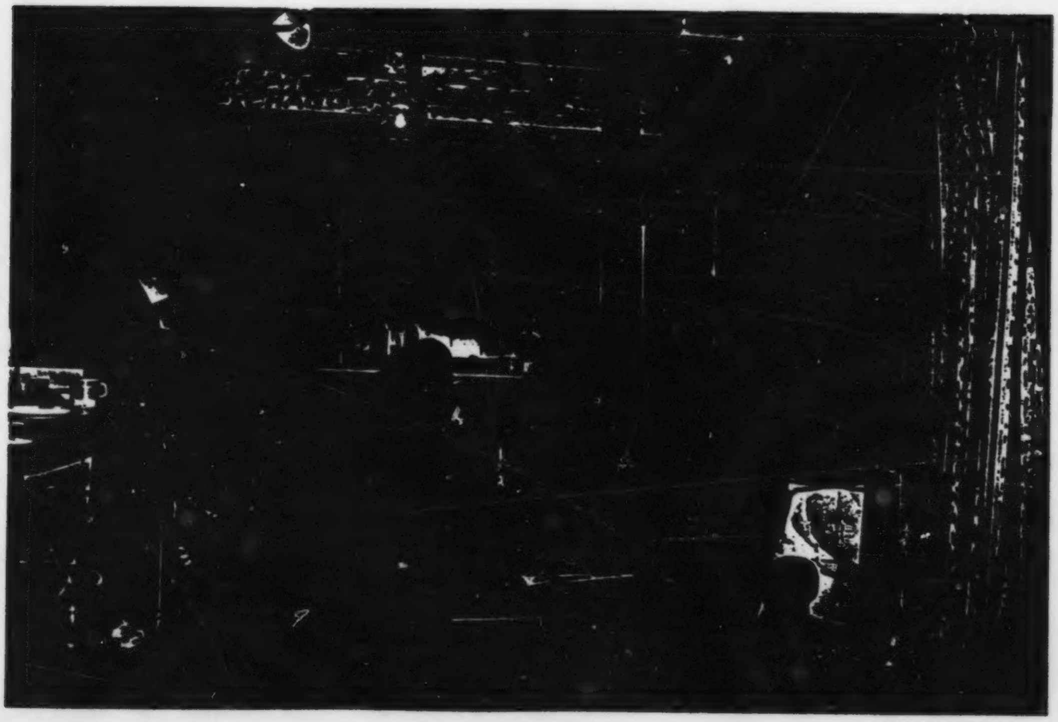
Wood Left Over After Winter Heating Season

The fresh air heat exchanger kept the houses fresh and not overly humid. No houses had evidence of condensation forming on the windows even in the coldest weather. As well, the air smelled fresh, even in houses where cleaning, curing and cooking of game meat was being done on a regular basis.

Jeremy Jenkins inspected all the units and did carbon monoxide tests and tests for air leakage. Since the carbon monoxide tests were all negative (i.e. a reading of zero) it was decided at that time to only do this test once a month instead of weekly, unless a positive reading was found, in which case it would then be more intensively monitored.

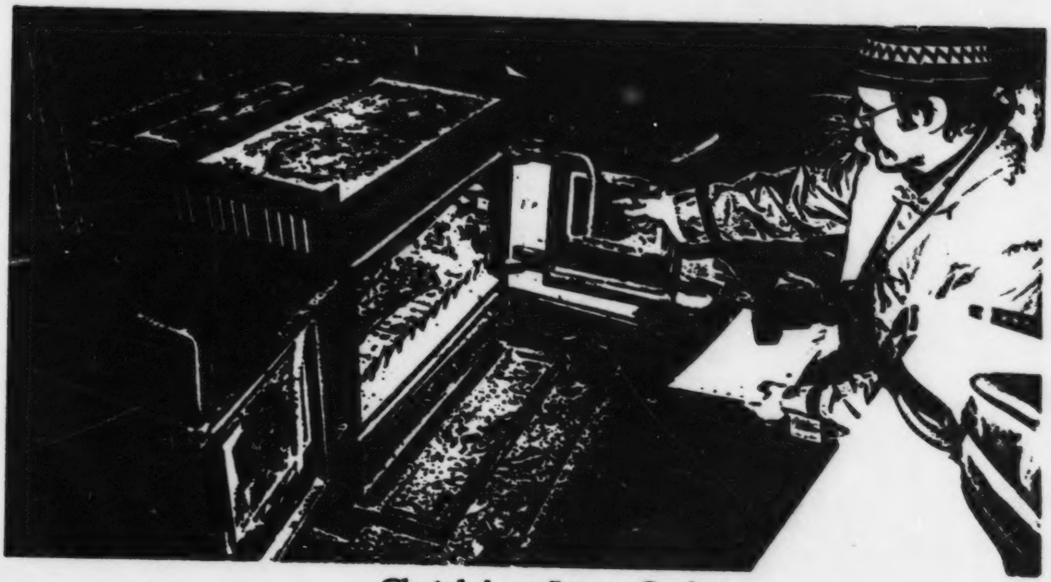
The air leakages found were minimal, only detectable through one duplex receptacle in all of the 10 houses tested. This shows how important the fresh air heat exchangers are for the safe operation of the wood stoves. Mr.Jenkins was up to Peawanuck again from April 6th to 8th, and changed the hygrothermograph paper, and again tested for carbon monoxide. The CO tests were again all negative. These CO tests were repeated on every trip right up to January 1988, and at no time did any test indicate the presence of any carbon monoxide.

The wood in the Priest's house where the wood furnace was installed, was weighed and averaged only 8.3 lb.(3.7 kg) per day in the month of April.

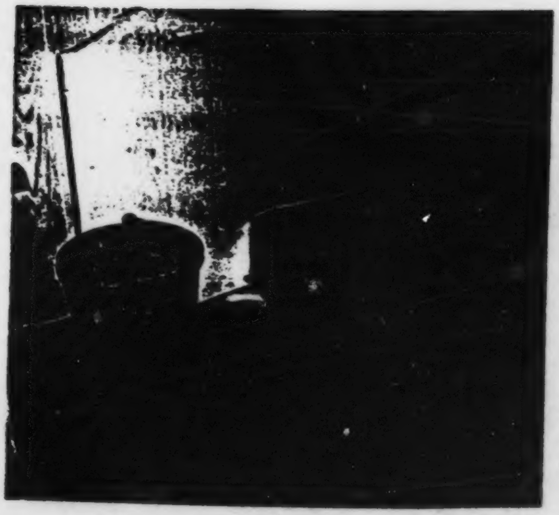


Wood Box!

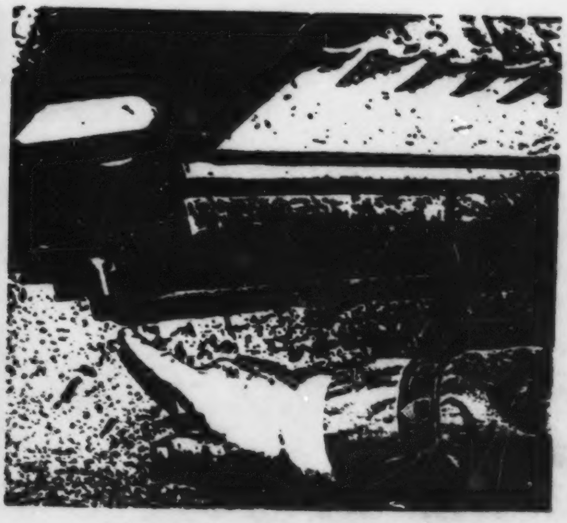
The chimneys had been cleaned out once in the 4 months since start up. This was prompted by one chimney fire (which did no damage). One of the houses had a serious fire, but not as a result of anything to do with the wood stove or chimney. However all the fire extinguishers were used up in fighting this fire. Therefore new or refilled fire extinguishers were ordered as replacements. Also new ash buckets were ordered since many seem to be misplaced.



Chatelaine - Loose Gasket



Ashes in Cardboard Box!



Chatelaine - Missing Bolt

It was felt that intensive long term monitoring (i.e. 8 months) as originally proposed would serve little purpose since the wood is difficult to weigh precisely and the exact result would not be really accurate beyond probably 75%. Therefore an extrapolated result was deemed adequate. It was planned that when cold weather would again return to November the monitoring would be redone in an attempt to achieve a minimum of one month's consistent results.

Selkirk Ranger

9:2 THE COOKSTOVES:

We decided to try the cookstoves on the recommendation of John Guenin, Executive Director of the Canadian Wood Energy Institute, who was very enthusiastic about these stoves and arranged for Tom Hendrick of Elmira to visit and present a case for using these stoves. Mr Hendrick was also very persuasive and claimed that they had been selling lots of these stoves to native communities in Manitoba.

These stoves were claimed to be able to heat water and could be hooked into a water pressure system. This was a major factor influencing our decision. Later we found that this water heating system was not proven and therefore we did not order the pressure tank and that system to go along with these 2 stoves. The stoves had an integral water tank.

The Findlay Sweetheart cookstove had been installed in house #8 and the Findlay Oval cookstove had been installed in house #9, but the occupants had abandoned these stove since they were so displeased with them and replaced them with regular woodstoves. Therefore we were not able to do any monitoring of these two cookstoves.

Oval Cookstove Bites the Dust

The stoves were installed and operated for over a month before they were rejected. We believe the rejection was caused by the following factors:

1: These were the different stove types than all the other more conventional woodstoves, which were working well and were familiar to the people of Peawanuck. Therefore they were thought of as experimental.

2: The cookstoves were installed on the upper level of the houses and did not heat the basement adequately. The basements were around 50 to 60 degrees F which is uncomfortable. Fans may have alleviated this problem, and were ordered but were never installed in time.

3: The main complaint about the cookstoves was related to the fact that the woodbox was small and therefore only a few small pieces of wood could be put in at one time. This was a valid complaint when you saw how the other stoves were used and how these cookstoves could not hold a fire overnight whereas the woodstoves needed to be filled only twice a day.

4: The cookstoves were more complicated to operate and looked a bit imposing. This may have been a factor. As well several of the parts on the stoves were broken or missing, maybe due to shipping , or maybe due to the occupants experimenting with the operation of the stoves.

5: The water heating feature was not really appreciated. Other people just heated the water in big pots on top of their woodstoves and since they had been doing this for years, there was no complaint about this method of heating water. The cookstove water tank on one had not been used when I inspected the stove.

6: The design of the house was such that the kitchen was at one end of the house, and therefore the cookstove. A better design would have been to have the cookstove in a central location with all rooms radiating from this central space.

If this type of stove were to be used, the house should have only one floor or else have the kitchen on a lower level and should have the installation in the centre so the heat could radiate. A larger woodbox would be desirable in order to count on the stove for spaceheating. Otherwise, I would not recommend its use in a northern house unless used mainly as a cookstove.

Later, one of the cookstoves was re-installed in the basement of the house but the complaints remain with regard to the amount of heat and the size of the firebox. The water tank has still not been utilized.

9:3 INSPECTION BY CHARLES LEMAY:

From March 2nd to 4th, 1987, Charles LeMay, who is a professional woodstove consultant from the Institute of Appropriate Technologies, and has done extensive work with native communities in northern Quebec, was in Peawanuck to inspect the installation and operation of the woodstoves. A copy of his inspection report, which we are generally in agreement with, is attached as Appendix "B" and the following are comments on this report.

9:3:1 LeMay Section II-A-1; General Observations.

We certainly agree that a particular person should be hired to do the ongoing maintenance so that as problems develop, he can rectify them and warn all persons who might experience similar situations. His long term involvement would be an asset to the community as well as for information transfer to other communities.

The main problem is that no agency has a budget for such a person. We suggested to EMR that the monitoring be reduced and the budget utilized to hire such a person for at least a period of one year. However, so far this has not been approved.

To add to our difficulties in this area, the person who we hired to do the monitoring of the wood used simply did not do any of this work during the first month that he was assigned this job even though he was being well paid to do this work. He seemed to be enthusiastic , yet the results for that month were lost.

9: 3:2 Chimneys (2.a):

The recommendation to remove the chimney caps during cold weather is against the code and should be done only on an experimental basis and only if we can be assured that the situation will be closely monitored. This will depend on hiring a person to do the monitoring, and if no really reliable person is available, I believe this experiment should not be attempted. In any case, the chimneys where the ice formed did not become a problem due to blockage in 1986 and this phenomenon may well not actually be a problem.

9:3:3 Flue Pipes (2b):

2.b.1: The homeowners have all been advised of the proper clearance from the stovepipes as well as from the stoves. Yet as observed there were some people who had clothes, wood, old caribou heads and other combustible odds and ends within 18" of their stoves. This is a matter of education and repeated warnings, preferably by the person who would be responsible for the ongoing maintenance. A stove board reaching to the limit of the clearance area would better define this area.

2.b.2: The stovepipe thickness variance was the result of the supplier substituting some inferior pipes. These will be replaced by regulation thickness pipes, however the pipes as installed are not dangerous.

The one galvanized elbow will be replaced as soon as a new section arrives in Peawanuck.

The screws for the joints were shipped, but not installed properly. There have been more screws ordered and these will be installed with 3 per joint as required. In the meantime it should be noted that the stovepipe is tightly fitted between the stove and the upper insulated flue and cannot inadvertently fall out, so the situation at present is not a hazard.

We do not agree with Mr.LeMay concerning his idea to install a base tee cleanout on the stovepipes. This would entail adding a convoluted section of two 90° bends in the stovepipe and still rely on the owner to do the cleaning out of the system. The bends would be susceptible to damage by passersby, including the kids who play in the basement, cause the smoke path to be slowed and may cause some creosoting which, as is has not caused any problem and not really solve the cleanout problem. Rather, this inspection and maintenance can be done as the setup exists. It should be done by a maintenance person who will be hired by the Band. This is the only way to ensure that this will be done on a regular basis to maintain a safe condition.

9:3:4 Stoves and Furnaces (2c):

2.c.1: The stove missing the certification plate is a certified stove and this has been verified by the supplier.

2.c.2: This problem with combustible materials being placed too close to the stoves can only be rectified by education and constant warnings. We will paint a line around the stove on the floor to remind people of this dangerous area.

9:3:5 Operating Condition (3):

These missing and broken parts of the stoves will be replaced or repaired by the maintenance person employed by the Band. All the required parts have been ordered and are presently in Peawanuck ready for installation.
The wood furnaces will be connected to their furnaces by the contractors who installed them.

9:3:6 Mounting (4):

The stove boards which were installed are within a few inches of being the proper size and were supplied incorrectly from the shipper in Winnipeg. New stoveboards have been ordered and are already in Peawanuck and are being installed at this time. The existing stoveboards will be doubled up and new ones placed under the other stoves in order to give the proper dimensions.

9:3:7 Stove Operation (5):

The occupants of the installation mentioned have been warned of their particular situation and are monitoring this situation. We are also inspecting the installation every time we are in Peawanuck. The chimneys are being cleaned regularly and this chimney will be cleaned more often if the situation warrants.

Safety Equipment (5d):

The ash buckets and shovels were ordered and originally installed in the houses. However during construction and the move-in it seems that these items have been used elsewhere. So, we are having to replace them.

There are two smoke detectors in every house, one in the upper level which is battery operated and one electrically operated in the basement. The location and installation of these smoke detectors were approved and inspected by the CMHC inspectors. Some of the detectors seem to be very sensitive and may have to be moved, however this reduces their effectiveness in case of a fire. However this is a better solution than having them covered or disconnected.

As indicated above, the fire extinguishers were used up fighting a fire in one of the houses; and replacement extinguishers have been ordered and will be installed as soon as they arrive in Peawanuck.

Warm Air Distribution, Furnace Ducts (5e.1):

The furnace ducts will be revised to reflect the requirements by the contractor who installed them in the first place.

Floor Vents and Open Staircase (5e.2):

The house was purposely designed so that the open stair and floor vents act as the circulation system for warm air throughout the building. This is the only way to distribute the heat without utilizing mechanical fans and in fact the system works very well as observed in the houses in Peawanuck. The whole house must be thought of as one space from a heating and also a fire point of view.

Fire resistant materials have therefore been used throughout. In the house that caught fire, the fire started in one of the basement rooms , possibly as a result of an electrical malfunction. However it did not spread by means of the floor grilles, although it did burn right through the basement floor and through the exterior wall in one location. As well, smoke damage was extensive. The fire was contained and put out and the house was saved and is being repaired at the present time. Therefore, caution is certainly advised regarding the smoke and fire hazards, but the situation is not dangerous.

Charles LeMay Inspecting Selkirk Ranger

9:4 THE SECOND MONITORING - NOV. 1987

The hygrothermographs were shut off as of May 6th and were stored over the summer until the cold weather in November.

J. Jenkins made a trip to Peawanuck on August 14, 1987 to check for safety related problems with the stove installations so these could be rectified before the soon to begin new heating season.

A list of items required to do the repairs and correct deficiencies was prepared, then these items were ordered.
Preliminary arrangements were made to hire Paul Koostachin, a local Band member, to monitor the wood consumption. He agreed to do the monitoring work once the cold weather began. Mr.Norval Goddard, an instructor with Northern College in Moosonee who was doing some carpentry training with some Band members was hired to gather the data collected by Paul.

Trip of October 23rd:

On this trip, J.Jenkins was accompanied by Elliot Rodger, Bill Peden, and John Newton of Energy Mines and Resources, who spent several days in Peawanuck inspecting the houses, the heating systems and the new town.

A decision was made to restrict the monitoring to 8 relatively typical "family" houses and to measure the wood consumption by cubic volume instead of weight. One sample lot of wood was weighed as a weight-to-volume comparison. Hygrothermographs were set up in the 8 houses and Paul Koostachin made a standard size wood box for each of these houses and measured the amount of wood used. Norval Goddard helped Paul build the wood boxes and collected the data gathered as well as helped with any problems which arose. The 8 houses are indicated on the enclosed site plan of Peawanuck in Section 4 and are listed on the monitoring data chart in the next page:

House No.	Occupant	Stove Type
House #6	Alfred Metat	Lakewood Cottager
House #7	Susan Bird	Findlay Chatelaine
House #22	New Family	Selkirk Ranger
House #23	Priest's House	Olsen Wood Furnace
House #31	Dorothy Hunter	Heritage Cartier-1
House #77	Antoine Gull	Selkirk Ranger
House #79	Daniel Koostachin	Heritage Cartier-1
House #80	Luke Gull	Heritage Cartier-1

PEAWANUCK WOOD CONSUMPTION

House No.	Occupant	Stove Type	Heating Days Monitored	Wood Used: in Pounds	Consumption Of Wood Pounds/Day	Annual Consumption Pounds	Annual Consumption Cubic Metres	Annual Consumption CORDS
#6	Alfred Metat	Lakewood Cottager	44	948	21.55	3017	4.89	1.35
#7	Susan Bird	Findlay Chatelaine	45	1880	41.78	5849	9.50	2.62
#22	Mary Jane Stoney	Selkirk Ranger	49	2009	41.00	5740	9.32	2.57
#23	Priest's House	Olson Wood Furnace	46	1826	39.70	5558	9.03	2.49
#31	Dorothy Hunter	Heritage Cartier	41	1512	36.88	5180	8.41	2.32
#77	Antoine Gull	Selkirk Ranger	43	2295	53.37	7472	12.41	3.35
#79	Daniel Koostachin	Heritage Cartier	44	1676	38.09	5332	8.66	2.39
#80	Luke Gull	Heritage Cartier	46	not known				

The monitoring period ran from October 26 until December 11, 1987, a period of 46 days.

Tests for carbon monoxide were carried out twice during this period and in all cases, showed no trace of carbon monoxide.

Copies of all hygrothermographs results are attached as Appendix "C". The climatological data for the period monitored for the Regions adjacent to Peawanuck are attached as Appendix "D". The climatological data and wood consumption have been placed on each monitoring chart for comparison on a day to day basis.

The results of the monitoring are summarized on the table on the previous page.

The humidity levels in all houses averaged between 50 and 60 per cent with some readings up to 70 per cent. These are relatively high humidity levels for the dry winter time of year and reflect the fact that water heating is carried out by leaving large pots of water on top of the stove at all times. As well, much of the cooking is done by boiling water to make a soup or stew base, and drinks are usually hot such as tea or coffee and seem to always be available. This humidity level of 50 to 60 per cent seems to be chosen by the occupants as being the highest level which can be maintained without the windows frosting up. The humidity level can be controlled by means of the dehumidistat which controls the fresh air ventilation fan. By closely examining the temperature graph of Daniel Koostachin's house #79 it is possible to see the fresh air fan cutting in about two times every hour. This would introduce fresh air and at the same time it would drop the air temperature of the house by approximately 1 degree. This "lost" or diluted heat is, of course, the cost of having the fresh air and since it is such a vital necessity for both the occupants and the building, the little amount of extra fuel used as a result is a small price to pay.

Since the average annual heating days for Peawanuck are 240, by extrapolation this would indicate a total annual consumption of 5256 pounds, which equals 2.35 cords, which equals 8.51 cubic metres for houses using the Heritage Cartier-1 stoves and a total annual consumption of 6606 pounds, which equals 2.96 cords, which equals 10.73 cubic metres for the Selkirk Ranger stoves.

By looking at the period in April 1987 when the Priest's house was monitored, it can be seen that the use of degree days to predict the wood consumption is reasonably accurate.

9:5 INTERVIEWS:

Interviews of 7 families were conducted and are summarized as follows:

Daniel Koostachin; House #79. Heritage stove.
Mr.Koostachin, who is Paul Koostachin's father was critical of the Heritage stove in that he had to refill the wood box more often than he felt suitable. He preferred the larger Selkirk Ranger stoves that were installed in 15 of the houses simply because the wood did not have to be cut as small and the fire lasted longer since the wood box held more wood. He claimed the house was easy to heat, was never cold in the coldest weather and used about 2 cords of wood all season. He used the heat exchanger fan to bring in fresh air and there was no condensation on the house windows.

Antoine Gull; House#77, Selkirk Ranger stove.
3 People lived with Antoine Gull, and since he was elderly, they were at home almost all the time. He was very satisfied with the performance of the Selkirk ranger stove. He only needed to light the fire once a day in the early evening and then added some wood before bedtime. This would keep the house warm right up until late the next day. He was not sure how much wood he used , but it was very much less than he used in his old house in Winisk. He purchased the wood from someone else in the community who delivered it to his house.

His stove had a door latch problem, in that the handle was sticking, and he had solved this by jamming an axe head against the door to keep it closed. Paul Koostachin was to fix this handle.

Chief George Hunter; House 3#, Heritage stove.
George was pleased with the Heritage stove. It provided adequate heating during the coldest days in winter. He noted the substantial drop in fuel consumption compared to the old houses in Winisk.
He said; **" In the old houses in Winisk the stove had to look after the house, but in Peawanuck, the house looks after the stove."**
He felt that the RCDP study to decide which type of stove was best, was not really a significant part of the project since no matter which stove was used in these houses, it would have performed well due to the ease of heating the houses.

Susan Bird; House #7, Chatelaine.
Susan, a teacher, lives with her family in the house and looks after gathering the wood for fuel on a bi-weekly basis. One sled full of wood lasts about 2 weeks. A sled full is about 12 to 15 pieces of 12' long northern black spruce trees. She was satisfied with the Chatelaine stove although it had several parts that were not working, for example bolts to hold the ash door closed. This caused the stove to be hard to regulate. These defects are being repaired. The stove protective sheet metal top was always up which indicates that this top was not hot enough to heat water and only the stove box itself was hot enough for this purpose. This means that the safety aspects of the sheet metal cover were being circumvented.

Dorothy Hunter; House#31, Heritage.
Mrs.Hunter lived at home with her family and was in the house most of the time. The wood used was less than in her old house in Winisk, but she did not know the exact amount. The Heritage stove was very good and heated the house on the coldest days of the winter. She had pots of water heating on top of the stove constantly since there were several small children in the family, and this stove was well suited to having water heating on top, even though the top surface area was small.

Maurice Mack; House#60, Heritage.
The Heritage stove performed well over the past winter, but Maurice commented on the larger firebox in the Ranger stoves, and felt that the savings in cutting the wood into smaller bits as well as the advantage of being able to load larger quantities of wood at a time made the Ranger a better choice. He did not feel the overheating which might be caused by the larger stove would be a problem since the stove was in the basement.

Dorothy Hunter's Stove, Water Heating, Clothes Drying

9:6 ANALYSIS OF THE MONITORING RESULTS

Originally, it was felt there could be an accurate comparison of the efficiency and effectiveness of the different kinds of wood stoves. However, as it turns out, most of the different brands of woodstoves provide adequate heat and none burn an excessive amount of wood. It seems that ".......the house looks after the stove." Due to each occupant's individual lifestyle, and patterns of use of his stove, the results are not conclusive evidence which condemn or lay claim to benefits of any particular woodstove. However, general trends can be identified.

The difference in the stoves are mainly a result of the physical manufacturers differences, cost and usability.

The Findlay cookstoves were excessively complex and also poorly built. Broken or missing parts were a problem with Findlays as well as the Chatelaine. Obviously, the simpler stoves were advantageous in this regard.

A small firebox was a negative feature of the smaller stoves such as the Lakewood Cottager, the Heritage and the Findlay cookstoves. The only stove with a really large firebox, the Selkirk Ranger was the preferred choice with the majority of families since less wood had to be cut and a larger volume of wood would burn longer. However it should be noted that the smaller Heritage and Lakewood stoves were able to keep the house warm even during the coldest days of the winter even though they had to be filled more often.

The wood consumption of the Ranger stoves was greater than any of the other kinds of stoves, burning an average 9.7 lbs (4.4 kg)/day more wood than the Heritage stoves. However, the Ranger stove in Mary Jane Stoney's house only burned 41 lbs (18.6 kg)/day which is very close to the amount used in the other stoves. The Lakewood Cottager consumed the least amount of wood, only 57 per cent of the amount of wood used by the Heritages.

The potential problem of using an excessively large firebox is that the stove capacity is so large that overheating will occur. To reduce the overheating, the stove will be dampened and the resulting slow burn is inefficient and causes excessive creosote buildup.

It is significant to note that this overheating does not occur , mainly because the stove is located in the basement which acts as a large plenum which only distributes the heat by convection and radiations to the lived-in rooms above. Heat fluctuations are thereby indirect and can be controlled.

In fact, none of the stoves showed excessive buildup of creosote. The chimneys needed cleaning only once during the first heating season, and were cleaned again before the start of the 1987-88 heating season. This indicates that the large stoves were burned fast enough to avoid any creosote problem, which therefore indicates that they were not too large for the total volume of the house which was being heated.

All the stoves heated the basement to a sufficient degree to allow for a satisfactory uniform heat distribution throughout the upper lived-in rooms. There seemed to be no cold rooms and nobody mentioned this as being a problem when it was discussed.

The one house with the wood furnace is functioning extremely well. Of course the heat distribution is well looked after by the fan blowing warm air throughout the ductwork. The house is very comfortable no matter how cold or windy the weather is outside. This house used an average of 39.7 pounds of wood per day during the monitoring period which is close to the same amount as the average woodstoves. During the 2 week monitoring period in April 1987 this house used only 8 pounds of wood per day, which reflects the warmer weather and shows that the wood consumption is closely related to the climate outside.

The wood-oil combination furnaces were being used constantly in the oil only mode. The reason for this is that the occupants are employed and their jobs make the gathering of wood and maintaining the fire too time consuming. As well, their heating costs are paid for by their employer. The lesson may be that if dual systems are installed, the occupant will choose to use the easiest system unless the cost of doing this is his own responsibility and he perceives a saving of money in exchange for his efforts. Subsidized services and energy efficiency are not compatible.

Inspection for Creosote

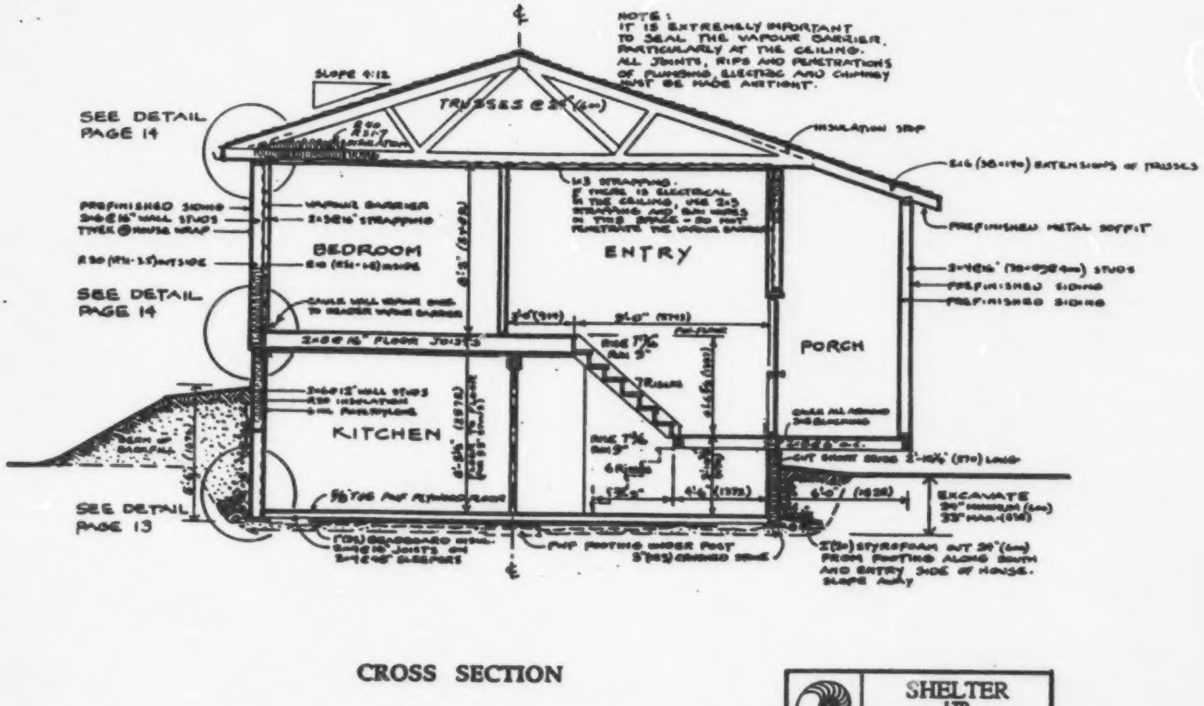
10.0 AN ALTERNATE DESIGN FOR WOOD HEATING

During the time when people moved into the houses in November 1986, they had to live in the basement, while the interior of the upper floor was being finished. Many people expressed how comfortable it was living in this manner which was essentially in an open space surrounding the central wood stove.

Based on this concept, a house was designed specifically for wood heating which has the living - dining - kitchen areas on the lower level and the bedroom above. The entry is split level and to aid in the air circulation as well as in aiding the accessibility to all areas of the house.

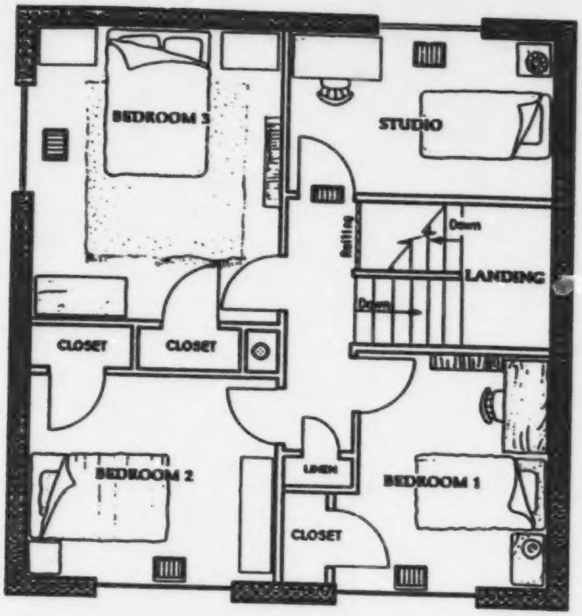
The drawings are done to indicate the smallest possible dimensions which are 24'-11 x 26'-4 (7595 x 8026). This allows for 4 bedrooms with 624 sq.ft. (5859 m) per floor. If more space is required or an additional bedroom this design could be lengthened up to 30' (9144).

The energy features of this house are similar to the Peawanuck houses, the useable floor space is actually larger, yet the outside dimensions are smaller. One important feature is the insulated bathroom which with a small back up heater can provide a heated space to protect the plumbing and any other freezable items for these periods of time when the occupants are away during the cold winter.

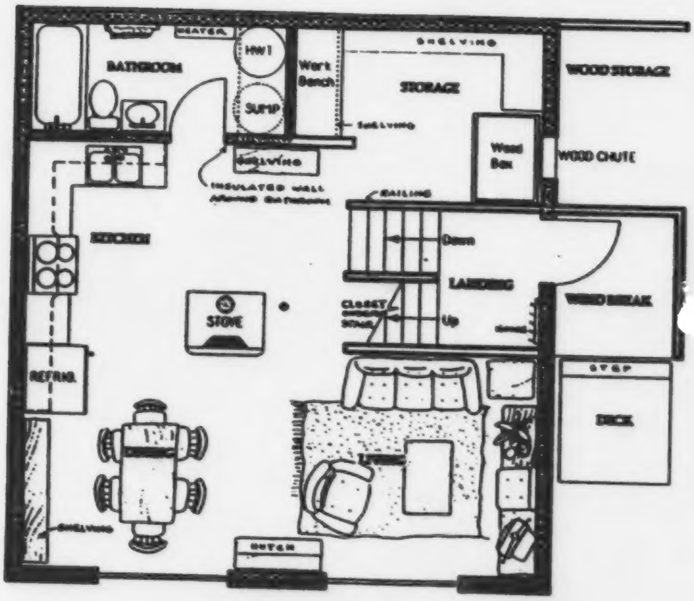


CROSS SECTION

SHELTER
LTD.
R.R.1, CALEDON EAST, ONT.
L0N 1E0
(416) 880-1048

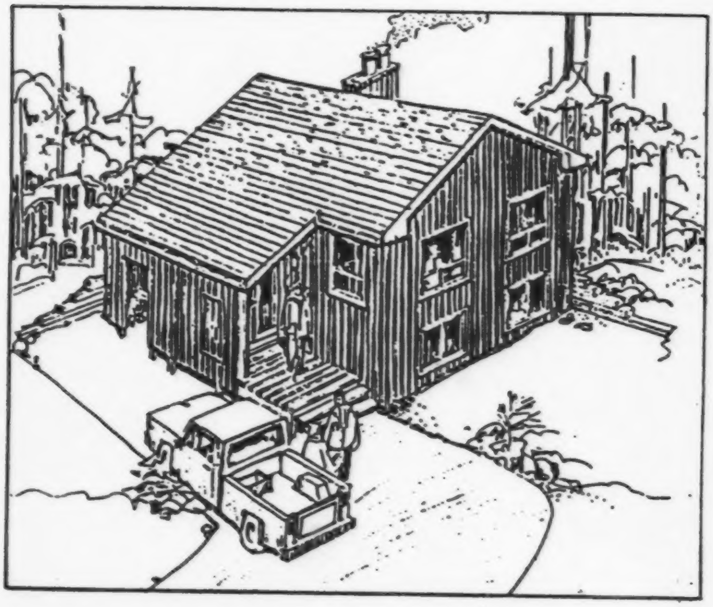


UPPER FLOOR PLAN



LOWER FLOOR PLAN

SHELTER
LTD.
R.R.3, CALEDON EAST, ONT.
L0N 1E0
(416) [illegible]-1048



11:0 CONCLUDING STATEMENT:

The original purpose for RCDP funding of this project was to determine the most appropriate wood stove for the houses which were being designed for Peawanuck. It soon became clear that the design of the entire house as a heating system was what was really required to improve the energy use in Peawanuck houses.

And this was done, thereby shifting the emphasis away from just the woodstove to the entire house.

The houses, including the heating systems, which were designed and subsequently built with the aid of this project embody many unique features and much common sense. The most significant point is that the houses work; they are 100% wood heated, burn a reasonable amount of wood and most importantly are very comfortable, both from the point of view of temperature and air quality. It is hoped the following summary will be of some use to those designing or planning to live in wood heated buildings throughout Canada.

Many recent studies have indicated housing to be one of the main concerns of Canada's remote communities, particularly with respect to quality, and problems of deterioration.

The direction to the solution of this housing problem may be found in the model of design and construction of the new community of Peawanuck. The local people were directly involved in the design and construction of their houses and the skills and pride which naturally developed are evident in the present community.

At present, local people are building more housing, as well as other complex buildings, and ongoing maintainance has been organized. Outside contractors and consultants are used when appropriate, but the community has become fully responsible for its future, both in actuality and attitude.

11:1 SITE PLANNING

11:1:1 Orientation: the sun provides a significant amount of solar heating if the building can be oriented to take advantage of it. Previous studies have shown that up to 45% of the heating can be from the sun, even with the relatively simple, conventional design used in Peawanuck.

Therefore, it is important when planning the street layout to provide for a southerly orientation for all the houses. This will mean that the houses are not necessarily parallel with the street, but will be parallel with each other while the street may be turning.

On streets running north-south, the same design can be used for either side of the street, but in all cases the main south facing windows will face sideways, that is, into the side yard.

If the street runs east-west, then a different design is required for the houses on the north and south sides of the street. Those of the north will have the main windows facing the front yard and the street whereas the houses on the south side of the street will have the main windows facing the back yard with the entry and few if any windows on the north or street side. Peawanuck Plan "C" is an example of this.

11:1:2 Windbreak: The streets in Peawanuck run roughly parallel, which is a common town layout. In order to keep as much natural green area and to preserve a windbreak within the townsite, the houses were kept relatively close to the street so that the area behind the houses between the street could be left undisturbed. This left an area of trees 80' wide: By running the infrastructure of sewer, water, electricity and telephone along the street, the excavation and manoeuvering of heavy equipment during construction and maintenance does not interfere with the green strip.

Areas of higher ground such as Peawanuck, which are most suitable for a townsite for many reasons, are unfortunately very exposed to the wind.

Therefore any break from the wind which can be made, or better, saved as in the case of trees, is a tremendous benefit to the town, mainly for aesthetic reasons, but not insignificantly for reasons of energy conservation because of the reduction of winds.

11.1.3 Fuel Supply: The town of Peawanuck is located at the very edge of the tree line. Although there are vast areas of forests around, particularity along the Winisk River's lowlands towards the south, the cold windy climate does not allow trees to grow very fast.

A tree from the Peawanuck area of 6" diameter may be up to 120 years old.
Therefore, it is vitally important to a community relying primarily on wood fuel to conserve the supply.

This can be done by using low energy use buildings to conserve fuel and the available supply as efficiently as possible.
At present, wood is gathered by skidoo drawn sleds from areas which had be burned by forest fires. It can also be cut from areas upriver and floated down to the townsite.
However the areas of large trees within reasonable distance are not inexhaustible, and care must be taken, along with proper planning, to conserve this supply so that future generations may also be able to enjoy the natural benefits of living in this area.

11:2 THE HOUSE

11:2:1 It is very evident from this study that in Peawanuck, "the house looks after the stove".

By making a low energy house, the stove does not have to be burning at peak performance all the time whenever the weather is cold.

This reduces fuel consumption and makes the stove last longer.

The low energy features incorporated in Peawanuck were primarily as follows:

a) Insulation to the optimum level.
b) An orient for the best passive solar gain.
c) A well sealed house.
d) Ventilation and provision of combustion air by a controlled method.
e) Provision of an adequate heat source with uniform circulation heat.

a) Insulation

The insulation levels chosen were R30 walls, R40 ceiling and R20 basement. These were based on previous experience using HOTCAN heat loss analysis. The idea is to use the maximum cost effective amount of insulation, which will depend on the cost of construction, type and cost of fuel and the climate where the house is located.

Our study has shown that the most cost effective insulation method is by using fiberglass batt insulation, rather than any plastic foam types and our wall design is based on producing a "fat" wall to hold the optimum amount of insulation, which in Peawanuck was 9" (230) thick.

For similar cost related reasons, all windows were triple glazed. Thermally broken, clad wood slider windows were used since they have proven to be the most simple and durable type.

It is necessary to have a well insulated envelope so that heat will distribute evenly within this envelope.

b) Solar Gain

Solar heat gain can be a significant source of space heating. To take advantage it is necessary to face as much window area to the south as possible. Usually houses will have a larger living room and dining room window, so the location of these windows will likely become the south side of the house. Windows on the east or west are acceptable whereas on the north should be minimized.

In the remote northern areas of Canada, the likelihood of overheating from too much glass is remote and may even be welcomed. Therefore the size of windows can be determined by the light requirement in each room or by the view desired, and of course the budget.

c) .Sealing

By sealing the house well, heat loss from air infiltration is minimized and drafts can be eliminated. Once the house is well insulated, the largest heat loss occurs by means of air leakage.

Careful sealing of all joints in the 6 mil polyethylene vapour barrier, including against all openings, is necessary.

The use of Tyvek house wrap further reduces air penetration from the outside, yet allows the skin of the house to breathe.

The best method of contraction with respect to the vapour barrier is one which allows for the inspection and repair of this barrier just before it is covered over and the protection of the barrier after being covered. For this reason the vapour barrier at the 1/3 point in the interior of the wall has proven to be very successful.

Ceiling strapping of 2" x 3" (38mm x 64mm) rather than the usual 1" x 3" (19mm x 64mm) provides a space for electrical and keeps ceiling screws, nails, and staples away from the vapour barrier above.

Many of the other construction details of the house are done for reasons of preserving continuity to the vapour barrier.

d) Ventilation

Because the house is sealed, fresh air for ventilation and combustion must be provided. By using a fresh air heat exchanger, the incoming fresh air is somewhat preheated, thereby reducing cold drafts and saving energy.

There are many commercially available heat exchangers and several might be suited to housing in remote locations.

However, for reasons of cost and simplicity of operation the site built design was used in Peawanuck, and it has performed very satisfactorily, as evidenced by the freshness of the air and lack of condensation.

By bringing in fresh air this means it is not necessary to open windows, which in the winter can prove disastrous to window longevity in northern areas where iced, frozen open windows are a common sight.

Also by exhausting the kitchen and bathroom fans indirectly through the exchanger, the often ineffective exhaust dampens are eliminated.

e) Heat/Circulation

An adequate woodstove or wood furnace must provide adequate heat even in the coldest weather, and be able to distribute this heat evenly throughout the house.

Both systems were used in houses in Peawanuck and both have proven to be effective.

The furnace distributes air mechanically, so would be most suited to a closed plan or larger building where heat distribution might be a problem.
In order for the woodstoves to work effectively, it was necessary for the house to have a relatively open plan to allow air to freely circulate. Both floor levels act as one large space.

The split level open entry and floor grilles around the perimeter allow for the required air circulation, and due to the high insulation levels and lack of outside drafts, this system does distribute the heat and fresh air uniformly throughout the house, through natural convection.

This arrangement of space makes the house plan more interesting than the usual bungalow and can open up opportunities for further design modifications to make northern housing suited to many individual needs and tastes.
A variation of the design is presented in Section 10 of this report.

11:3 THE STOVES

Because of the low energy nature of the house, the choice of the most durable, efficient stove is not an absolute necessity. This suggests that reasons such as personal preference or cost will have more weight in the choice than energy considerations.

All of the stoves and the wood furnace heated the house easily, using a reasonable amount of fuel under the most severe conditions.

The Selkirk Ranger was the stove preferred by most people. Several people have asked if they could have their stove switched to a Ranger. The reason is simply because it is a large box type stove and will take a large load of relatively long wood. This allows for long burn times, and the potential problem of overheating is alleviated by the basement plenum effect within the house. The stove was simple to operate and had a large flat top for heating water.

The Ranger was the least efficient, burning the most wood of all the stoves and has a lining which is easily dislodged if carelessly loaded.

The stove preferred by the consultants of Shelter after the initial study, and which was still highly regarded after the completion of the monitoring, is the Heritage Cartier-1.

After setup, there have been no maintenance problems with the stoves.

The only complaint, other than that the firebox was too small, related to the method of controlling the air. There are 2 controls which work in opposite directions which is a confusing procedure. The standard model has a glass door which is not suited to a remote application and which may limit the availability of this stove unless ordered with glass.

Heritage makes a similar, but larger stove which would allow larger wood to be burned and would probably not be oversized for the house given the stove operates in the basement.

For a house like the optional design shown in Section 12, the smaller Cartier-1 would be an ideal size.
In 1988, 10 new houses were built by the Band and the opportunity arose for the Band to choose different designs, or at least revise the designs which have been shown in this report. The only change was for 2' (600 mm) to be added to the length of the house in order to give larger bedrooms. The heating system was not changed and the stove selected for the new houses was the Heritage Cartier. Some of the larger Cartier II models will be tried.

The Lakewood Cottager, which would be our alternate choice, was by far the most fuel efficient stove tested, using about 60% of the average amount of fuel. The house was kept as warm as the others during the period and did not have any maintenance problems.

Since this is a small stove, the wood box size was a complaint, but this stove also comes in a larger model.

Both the Heritage Cartier and the Cottager are simple, welded steel, relatively inexpensive "box" stoves, which heated the house adequately, but had several maintenance problems.

The bolts fell off the ash door which may have affected the efficiency of the burn. During that period the occupant could not control the temperature.

The top guard was removed so that water could be heated in direct contact with the stove top. The outer stove guard was not felt to be of use, probably because the stove was in the basement.

Elmira cookstoves were not suited to this house or such a remote application as explained earlier in Section 9:2.

The Olsen wood furnace was excellent for comfort and uniformity of heat throughout the house. It burned the same amount of wood as the average woodstove.

Due to the ductwork, it is the most complex and expensive of all the heating systems and although the user never had a problem, a less experienced occupant could possibly be confused by the operating system.

The blower motor used enough electricity to be a problem for a house with a 20 amp service and of course the furnace had no place for heating water, so for these reasons it was not chosen for other houses in Peawanuck.

If regular inspections of the stoves and flues are carried out in the future and they indicate little creosote building-up as has been the case to date, then twice a year cleanouts of the chimney should be adequate. Certain houses may prove to be different due to an occupant's habits and these will have to be treated individually.

During these inspections, other repairs such as loose doors, faulty gaskets or other damage should be repaired.

Since several people have removed or covered their basement smoke detectors, these should be moved to a location so they do not go off except in a real emergency.

Problems such as these point out the necessity to have a permanent maintenance program in place along with a person who is responsible for its administration. This would be a part-time occupation for a person employed by the community for maintenance of public utilities.

It can only be emphasized that this is a serious matter which relates to the safety of everyone living in the community and deserves as much attention as maintenance of water, sewer and electrical services.

Smoke Detector Removed

3: PRELIMINARY INVESTIGATIONS INTO WOODSTOVES:

Following is a list of persons or agencies contacted with a summary of their recommendations for the new housing in Peawanuck:

3.1:
Cal Wallis
Wood'n'Energy,
McDonalds Corners, Ont.
K0G 1M0

Cal Wallis did considerable research into the types of stove which would be suited to the houses in Peawanuck and in view of his considerable experience with wood stoves and with wood heating in remote communities, his opinions were carefully considered. As well, being a stove dealer, he submitted prices for supply of the stoves which were useful in getting comparative prices when ordering the stoves.

Mr. Wallis recommended that 2 stoves be used in each house, one for heating in the basement and one for cooking as well as heating on the upper floor. He was extremely critical of the design of the house with its use of 2 floor levels and felt it would be uncomfortable since he felt the heat would not distribute throughout all the rooms, as well as dangerous due to the ease of spread of fire if both levels were open to each other. He felt that if one stove was to be used it should be placed on the upper level.

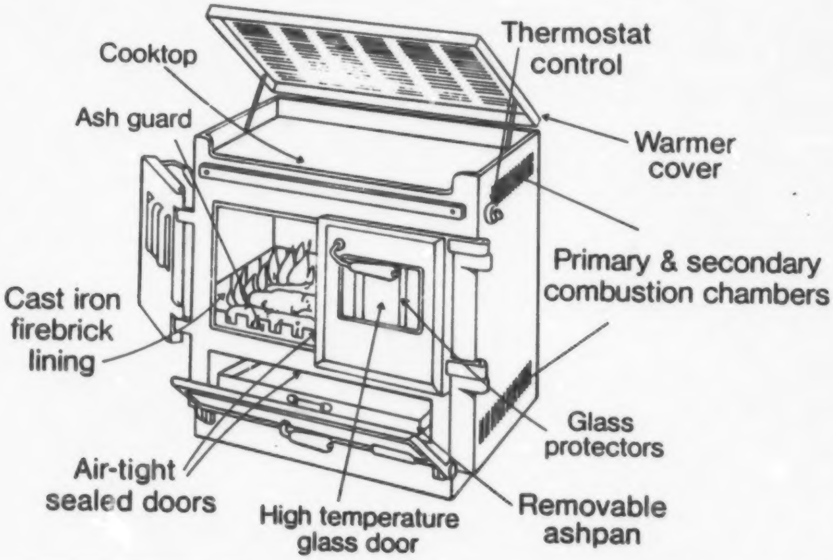
The stove recommended for the basement was the Findlay Chatelaine due to its ruggedness. The upper stove recommended was the Lakewood Cottager due to its durability, energy efficiency, proven record in remote applications and simplicity. He ruled out cast iron stoves due to their cost, availability and more complexity.

He was critical of the Elmira cookstoves due to his belief that their quality of construction was poor and they required high maintenance. He recommended the Krupa cookstove made in British Columbia. However they were out of stock and the company was up for sale, so we did not order this type of stove.

Although we never agreed with Mr.Wallis' concerns regarding the house layout, it made us re-analyse the design with regard to safety and heat distribution, and we are certain the design as built is safe and that the heat will get around to all the rooms without additional fans for distribution.

Based on his recommendations, we included the Chatelaine and the Lakewood Cottager in this project and installed 2 of each of these stoves in Peawanuck.

Mr.Wallis' doubts about the cookstoves was well founded and although 2 of these stoves were installed, they were rejected by their owners, but not before several parts had malfunctioned or fallen off and indicated they may well have been a maintenance problem if used constantly, which as heat sources they would have been.



Specifications (We reserve the right to make technical changes without notice.)
Width: 33"/838.2mm. Depth: 21"/533.4mm. √Height: 32"/812.8mm.
Height to flue: 31"/787.4mm. Diameter Flue: 6 ~~8"/203.2~~mm. (Standard)
Door opening: 24" x 12"/609.6 x 304.8mm. Wood length up to 25"/635mm.
Firebox: 16½" x 25" x 18"/645.1 x 635. x 457.2mm. (height to cooktop)
Heating Capacity: Up to approx. 2400 sq. ft./223 m²
Shipping weight: 325 lbs/147.41 Kilos

Findlay Chatelaine

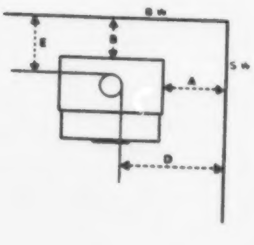
Findlay Comfort Systems, 107 Manitou Dr., Kitchener, Ontario Canada N2C 1L4

HEATS 1,000 To 1,500 Sq. Ft.

HERITAGE®
energy systems

23 Balsam St. (Hwy. 26 W.) Collingwood,
Ontario L9Y 4H7 (705) 445-5650

Cartier Clearances:

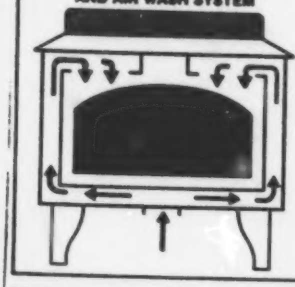


FROM CHIMNEY CONNECTOR
D. 23 IN.
E. 17 IN.
F. 20 IN.

CARTIER I

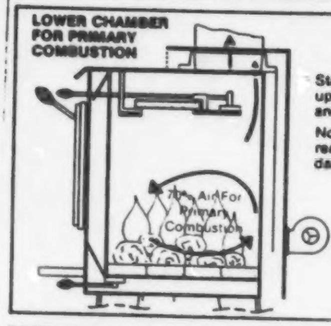
TOP FLUE WITH SINGLE WALL CHIMNEY FROM HEATER
A. 16 IN.
B. 10 IN.
C. 6 IN.
FROM CHIMNEY CONNECTOR
D. 25 IN.
E. 13 IN.
F. 14 IN.

COMBUSTION AIR AND AIR WASH SYSTEM



- Combustion air enters through bottom of stove.
- Air is channelled up both sides.
- Air is then injected down into lower (primary) combustion chamber across the glass doors.
- This provides a constant air wash for the glass.
- Air distributes 70% to lower (primary) combustion chamber, 30% to upper (secondary) chamber.
- Air is preheated for combustion by travelling through three feet of channels.

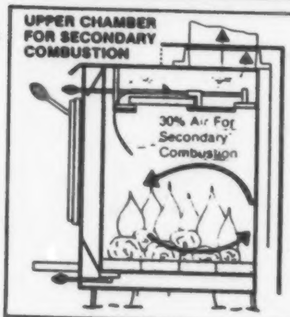
LOWER CHAMBER FOR PRIMARY COMBUSTION



Start fire, damper open. This will preheat upper (secondary) combustion chamber and flue to establish maximum draft.

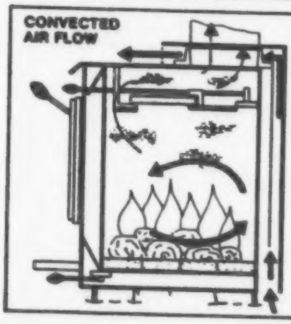
Note: Stove top temperature should reach 500° to 550° before closing damper.

UPPER CHAMBER FOR SECONDARY COMBUSTION



- Now with the damper closed, the intensely heated volatile hydrocarbons are forced into the uppor (secondary) combustion chamber through the multi-holed combustor plate.
- This mixes the gases and secondary combustion air.
- It then moves over the refractory brick baffle where the mixture is ignited and emissions are effectively consumed by the intense heat.
- The heat is then transferred out through the top of the stove into the room.

CONVECTED AIR FLOW



- You can maintain the desired temperature by repositioning the combustion air control at the bottom of the stove.
- You are now restricting the incoming combustion air and controlling the rate of burn..
- The convected air is now being totally heated by travelling through the indicated channels. This convected air can be assisted in its movement by an optional fan package.

3.2:

Craig Gutowski
Rainbow Energeteks Inc.
Highway 50 at Highway 7
Woodbridge, Ont.
(416) 741-2030

Craig Gutowski is a wood stove dealer who has been in the business for over 12 years. His practical information was very valuable and he submitted prices for the supply of all stoves.
His basic recommendation was to use a plate steel stove which did **not** use firebricks, mainly for the simplicity of the construction and operation. The firebrick may be a problem in shipping, breakage and improper installation. He did not feel cast iron would be suitable, even though they are easier to repair since you can change parts. They can crack easier if not properly fired and generally the designs are more complicated to use and require more education of the user. As well they are usually more expensive.
He recommended the Heritage or Kent stoves as being energy efficient, relatively inexpensive, simple to use , well constructed and as maintenance free as possible.
He felt the Chatelaine which Cal Wallis recommended was overpriced and not as energy efficient a design. As well it has a shield of light metal which reduces the hot top capability for heating water on top of the stove. Although it could be argued that this feature was an advantage if children were around.
He did not recommend the Lopi which we were considering due to the lower quality of construction, with the steel plate being thinner than the Heritage or Kent. He also did not recommend the Selkirk Ranger or Voyageur due to poor quality of construction as well as lack of innovative technology, which is to say they are less energy efficient than the Heritage.

We took Mr Gutowski's advice and persued the Heritage and Kent stoves and eventually purchased 22 of the Heritage model Cartier-1 stoves for use in the houses in Peawanuck. He arranged for the Heritage factory to custom build the doors so that the glass panels were replaced with a steel panel, which was obviously more durable. As well his prices were the best, for example he could give us a better price for the Elmira stoves than we could get directly from the manufacturer. As well, he was able to arrange for the stoves to be picked up from the factory and delivered directly to the Pickle Lake airport for further air shipment to Peawanuck. Therefore most of the stoves were purchased from Rainbow.

3.3:

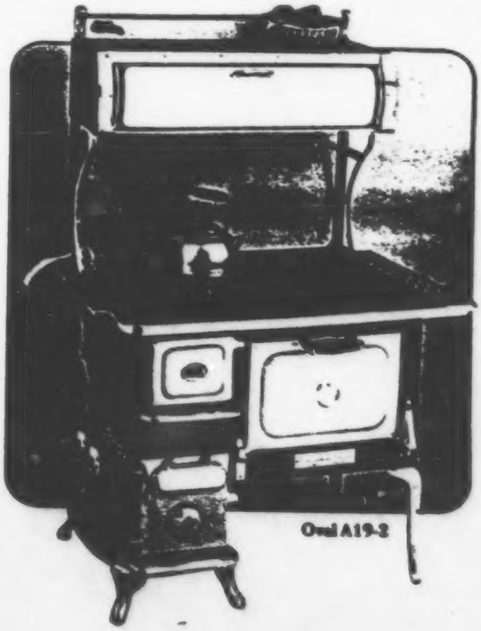
Tom Hendrick
Elmira Stoveworks
22 Church Street,
Elmira, Ont. N3B 1M3
(519) 669-5103

Tom Hendrick, the president of Elmira, was introduced to us by John Guenin of the Canadian Wood Energy Institute. Our interest in the Oval and Sweetheart cookstoves was initiated by the fact they both had water heating capabilities and also Elmira advertized an optional water jacket which could be connected into a hot water distribution system.

Mr Hendrick told us that he had sold many of these cookstoves to native northern residents in the province of Manitoba and a copy of a shipping bill for 31 stoves to Scanterbury Manitoba is enclosed. He claimed they had no complaints about the stoves and every year more were ordered.

We decided to try one Oval and one Sweetheart cookstove for this project in Peawanuck, however since the water heating system was not fully tested and proven, and we had negative reports about its safety and effectiveness, we decided not to try that optional extra at this time. These stoves had a water tank attatched and it was felt this feature alone would be useful in a house with no other hot water heating device.

Sweetheart A26-2



Oval A19-2

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Highway 50 at Highway 7
Woodbridge, Ont.
(416) 741-2030

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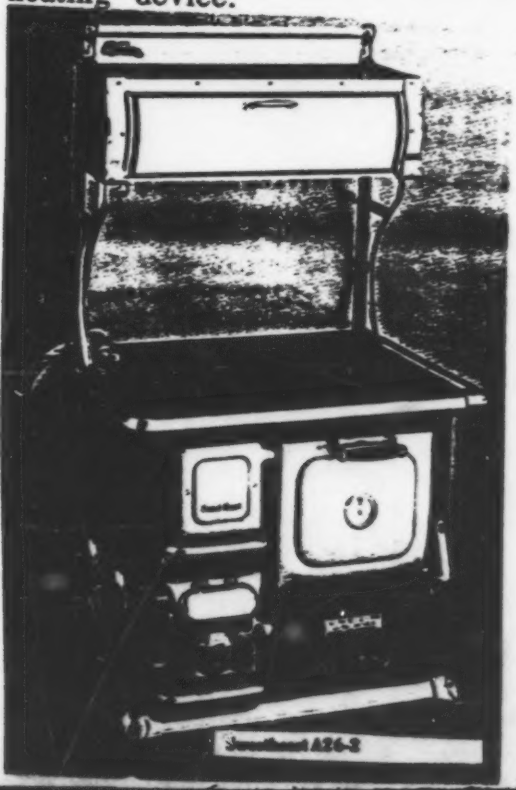
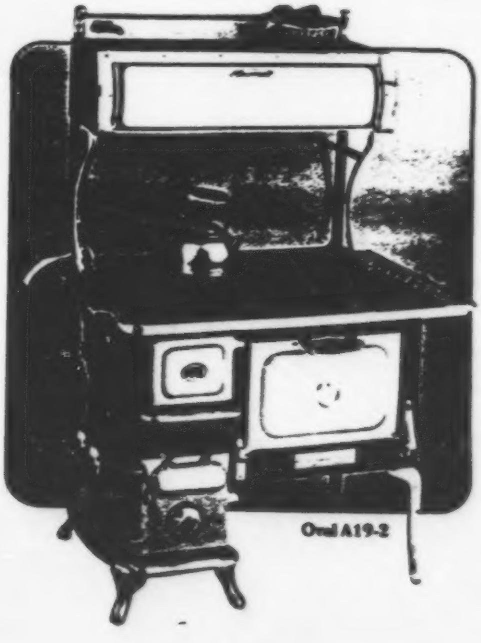


Sweetheart A26-2



Oval A19-2

A Thermosyphon or Convection Water Circulating System

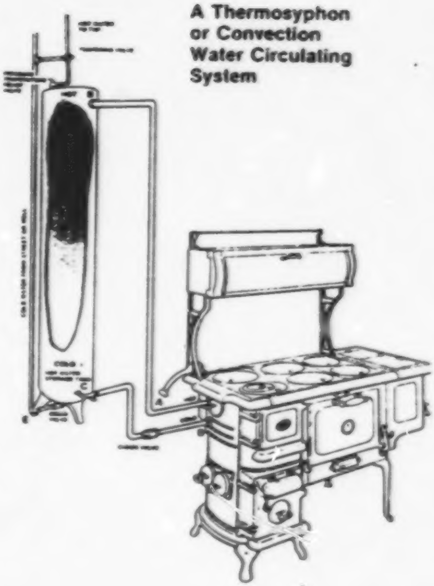
The thermosyphon or convection system is the most basic, dependable and fool-proof method of heating water with your cookstove. It uses the principle that hot water rises and circulates water from the storage tank to the stove and back. Cold water from the bottom of the tank falls into the waterjacket where it is heated...and rises back into the top of the tank. This is often referred to as a gravity system and if properly set up, will work automatically, putting hot water into your HOT WATER storage tank anytime there is heat in your stove.

For a thermosyphon system to work, your water storage tank must be raised at least one foot above the water jacket for every two feet it is located away from the stove. Example — If your stove is located six feet away from your water storage tank, it must be placed three feet higher than the outlet of the water jacket. (Therefore C on the diagram must be located 3 feet higher than A).

Use at least ¾" pipe in the loop from the tank to the stove and back. A 150 lb. pressure temperature/relief valve should be used on the top the storgae tank. All pressure temperature/relief valves should be piped to a drain. If entering the top of the tank with hot water from the jacket, install a 150 p.s.i. air vent at the highest point in that line.

Use a check valve in the cold water line leading from the tank to the stove between points C and D. (Arrow on the check valve must face the direction of the flow). Install a tempering valve in the hot water line above the pressure relief valve. Install a drain valve at the lowest point in the system.

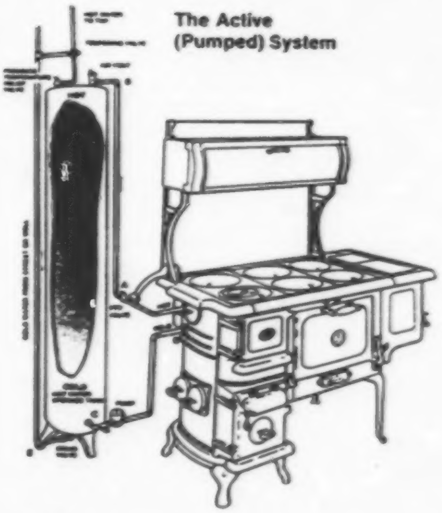
Be sure there are no ups and downs in the cold water line to the jacket. It is a good idea to give all the pipes from the stove to the tank a slight uphill slant so no air will become trapped in the lines. Also, watch that there are no gate valves between the jacket and the storage tank because if closed, could cause serious damage to the system.


A Thermosyphon or Convection Water Circulating System

The Active (Pumped) System

This is the system to be used when your storage tank is located either below the stove or a great distance away. This system is set apart by the use of a pump to circulate water, and a heating sensing controller may be used to activate the pump when the stove is operating. Because an electric pump is used to move the water through the system, additional safety precautions are required. In the event of a power failure, water could stop moving and become highly pressurized in the water jacket. To release this pressure, a pressure temperature/relief valve (P.T.V.) located in the hot water line about two feet from the stove is a must and should be piped to a drain.

Will you be using a thermosyphon or a pump? A system with a pump can produce twice as much hot water as a thermosyphon system.


The Active (Pumped) System

OVAL, JULIA AND SWEETHEART Water Jacket Installation Instructions

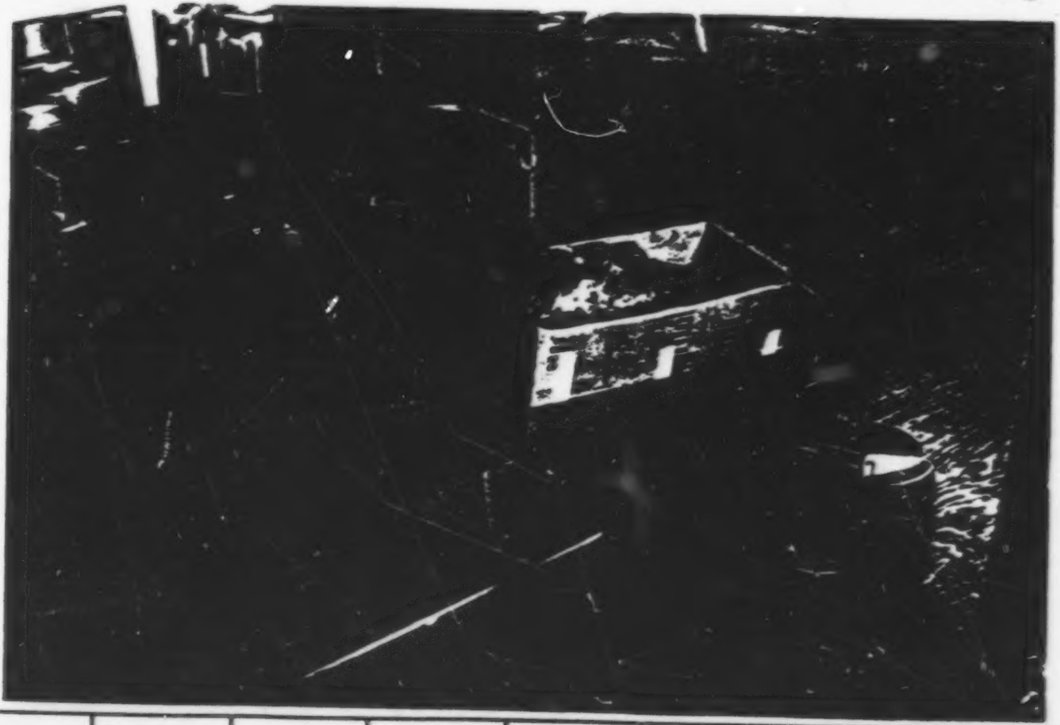
3.4:

Jerry Carson
Heritage Stoves
23 Balsam Street
Collingwood, Ont.
(705) 445-5650

Mr.Carson was very helpful in presenting the options available from Heritage regarding their welded steel stoves. These stoves do not rely on firebrick lining, are relatively energy efficient due to a secondary combustion chamber design and are simple to operate.

The glass front on the door was felt to be unnecessary in Peawanuck and even could become a maintenance problem, and therefore we decided to change this to a steel panel, although 2 of the stoves were ordered with glass to see if there really was any difference. It was claimed the glass allowed more radiant heat into the room than the steel panel. Heritage made this change for us at no additional cost.

The stove chosen for the houses in Peawanuck was the Cartier-1 model which is their middle sized stove, taking wood up to 18" long.



MODEL	DOOR OPENING	WOOD SIZE	WIDTH	DEPTH	HEIGHT	WEIGHT	FLUE COLLAR SIZE	AREA HEATED
PETIT CARTIER	9⅝" x 14⅝"	16"	21"	15⅛"	27"	285 lbs.	6" Inside Diameter	600 - 1,000 sq. ft.
CARTIER I	10⅛" x 17⅛"	18"	24"	21¼"	29¾"	325 lbs.	6" Inside Diameter	1,000 - 1,500 sq. ft.
CARTIER II	11" x 21⅛"	24"	29⅛"	21¼"	29¾"	385 lbs.	6" Inside Diameter	1,500 - 2,000 sq. ft.

3.5: Charles Lemay
Consultant for Cree Housing
Appropriate Technology Research Institute
P.O.Box 250, Clarence Creek, Ontario
K0A 1N0
(613) 446-4829

Charles LeMay, an experienced researcher and consultant in the woodstove field was hired as a subconsultant to advise, inspect and report on the installation of the stoves in Peawanuck, particularly with regard to safety. He has done on a continuing basis, a study of wood burning stoves for the northern native community of Eastmain, Québec.

The stoves he recommended are the Lakewood Unicorn Catalytic, the O'Dette Pioneer and the St.Georges Baron 1880. As well he made many other recommendations concerning chimneys, sizing of the stoves, installation, maintenance and safety which were very useful in designing the house as well as choosing the stoves to use.

He was ambivalent in his recommendation of a catalytic combustor and since wood supply is not a major problem in Peawanuck the extra efficiency gained was not felt to be an advantage over the possible maintenance problems and cost of regular replacement of these combustors. Therefore we did not supply any of the stoves in Peawanuck with these catalytic combustors.

3.6 John Guenin, Executive Director,
Canadian Wood Energy Institute
85 Curlew Drive,
Don Mills, Ont. M3A 2P8
(416) 445-6296

Mr. Guenin was very helpful in giving us information as to which manufacturers were available, although he only represented Canadian suppliers, and although all the stoves which were eventually installed were Canadian made, we were considering several imports at that time as well.

Because in the beginning, we were looking for a water heating supplement for the woodstove if at all possible, he recommended the

Elmira cookstoves, and introduced us to Tom Hendricks. He had several useful comments about the design of the housing such as the requirement to use fans to distribute the warm air, and the benefits of using a wood burning furnace which would have its own fan and hot air duct system.

We did order one wood furnace, one wood-oil combination furnace and several oil burning furnaces for use in the schools and office buildings which were the same size as the houses and of similar construction. We have been monitoring the wood furnace and one of the oil furnaces for comparative reasons as part of this project.

3.7 Greg Allen
Allen Associates
33 Madison Avenue,
Toronto, Ont. M5R 2S2
(416) 962-6193

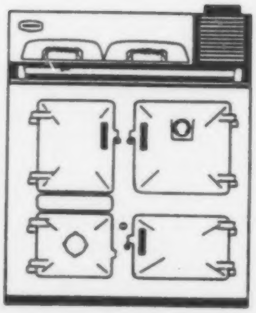
Greg Allen was hired to do an analysis of the mechanical and electrical equipment for the housing in Peawanuck and a copy of his report is attatched.
We put more weight to his general recommendations and general ideas than any other person whom we talked to during this study.
His main recommendation was to use a wood stove which would distribute its heat by natural convection due to the high cost of operating any sort of fan for air distribution.

By locating the woodstove on the lower level and allowing the floor to heatup and radiate heat upwards, as well as placing some vents for convective transfer, he felt a good heat distribution could be achieved.
He recommended the Lakewood stove, or some welded steel equivalent, and this is what we did choose for the most part.

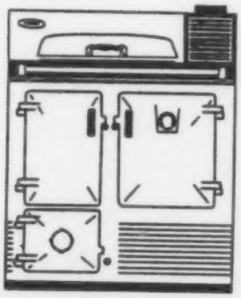
He recommended an Air Changer heat exchanger for supply of fresh air and we did use a heat exchanger, however, built by the contractor, for reasons of economy.

Because of the large amount of energy needed for hot water heating, he also recommended the use of a stove which could provide hot water such as the Rayburn from Ireland or the Godin from Belgium. Much effort was put into finding details of these stoves, but in the end neither was tried because of the high cost ($2,600.), untried nature of the setup required (at least in Canada) and the problems in ordering, shipping and maintaining a "different" type of stove from a source outside the country. We believe these stoves could be a real benefit in remote applications such as Peawanuck once proven and if proper distribution of stoves and parts is set up in locally. The basic idea of a wood cookstove with a boiler for hot water which can hook into a pressure system is quite appealing.

SOLID FUEL
'Sunbrite'.
Anthracite,
Dry steam coal,
'Rexco', 'Coalite',
'Phurnacite', or
Household coal.
as recommended



Rayburn Royal
33" wide x 39¼" high including splash-plate, x 22⅝" deep including hand-rail.
Hob height 32¼".
Hotplate 21" wide x 7¾" deep.
Hotplate insulated covers supplied as standard. Extra oven for slow cooking and plate warming. Left-hand or right-hand oven. Back boiler, for heating 30 gallon hot water storage cylinder.
Choice of colours – white or cream.
Plate rack available at extra cost.



Rayburn Regent
30" wide x 37" high including splash-plate, x 23" deep including hand-rail.
Hob height 30".
Hotplate 21½" wide x 7¾" deep.
Left or right-hand oven.
Back boiler for heating 30 gallon hot water storage cylinder.
Choice of colours – white or cream.
Plate rack available at extra cost.

Our new solid fuel Rayburn is much more than just a cooker.

The compact unit will now heat several radiators and provide gallons of piping hot water.

Of course, we hardly need to praise Rayburn's performance in the kitchen. Its famous cast iron oven has been around long enough to collect testimonials from cooks the world over.

What is new, apart from this Rayburn's extra capability, is its adaptability.

THE OPTIONS OPEN TO YOU

Solid fuel (Anthracite, French Nuts, House Coal Trebles or Doubles, Phurnacite, Rexco and Royal).

You can have domestic hot water, with or without central heating (Up to 100 sq feet radiation area).

Wood (logs, wood-blocks, peat briquettes).

You can have hot water, with up to 53 sq feet of radiator area.

Even when fuelled by wood, the new Rayburn will burn through the night unattended for up to twelve hours.

Colours. You can have it in stunning matt black, white or cream.

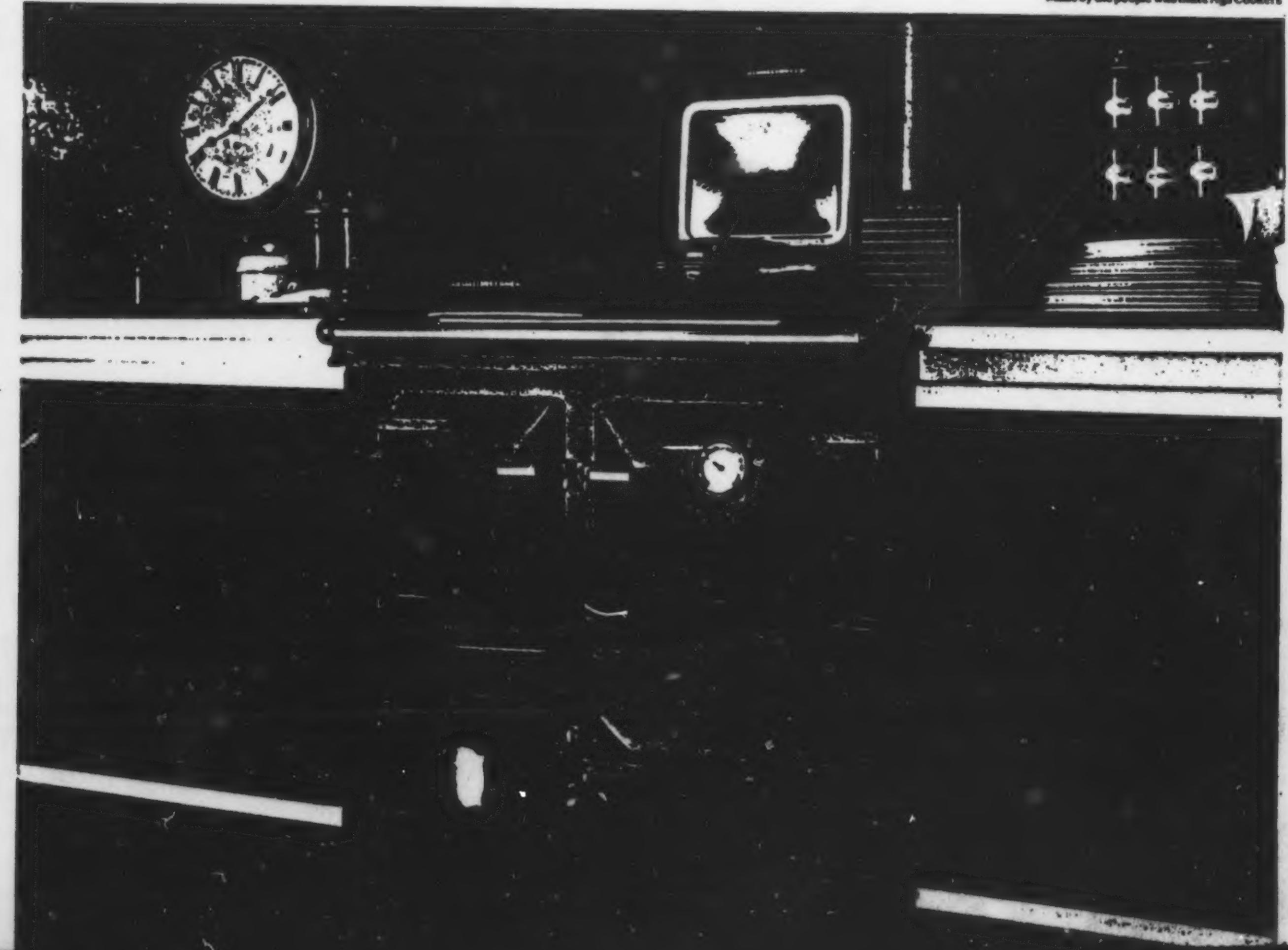
Dimensions. 33" wide. 22⅝" deep. 32¼" high hob. 39¼" high splash back

Hot water supply. The boiler should be connected to an indirect cylinder of 190 litres capacity (40 gallons) and using solid fuel a towel rail should also be fitted.

The MF will provide 100 gallons of domestic hot water every 24 hours when burning solid fuel or wood.

RAYBURN

Made by the people who make Aga Cookers



Allen
Associates

APPENDIX A-12

33 MADISON AVENUE TORONTO ONTARIO M5R 2S2 (416) 962 6193

July 10, 1986

COPY

Mr. Gordon Flagler
Sales Representative
AGA
22 Austin Terrace
Toronto, Ontario

Dear Gordon:

We would first like to thank you for your generous efforts to provide us with the appropriate information for the Weenusk Project.

The purpose of this letter is both to provide detailed background of the project and to request more information from AGA. I trust you will pass this letter on to the appropriate person as required.

As you may have heard the town of Winisk (or Weenusk) was destroyed by ice and flooding this spring. The town was located close to the mouth of the Winisk River near the southern coast of Hudson Bay in Northern Ontario. The residents are almost exclusively Indians from the Weenusk band. The town is being moved several miles up-river to a newly prepared site. The housing will be one-storey bungalows with full basements and it is anticipated that pressurized mains water will be available.

After our meeting regarding the stove option we met with Jeremy Jenkins, the architect responsible for the whole town development. He reports directly to the band chief who is in control of the band's funds. It is worthy of note that, while the band has obtained low interest mortgages from CMHC, there is no disaster funding available and the residents will eventually have to pay in full for their own replacement housing. The project will be developed in two phases for a total of 72 houses, 42 of which will be built this year, the rest in the summer of 1987.

As we have mentioned, the strong interest in the Rayburn Royal Stove is due to the high electrical costs (approximately 3.5¢/kWh) and the limited generating capacity (20 amp service per house). This precluded the installation of electrical ranges and water heaters. Wood, however, is readily available, constituting potential savings of about $1,000 per year per house.

As a firm with considerable experience in wood heating for Canadian housing, we are impressed with the capabilities of your product that are clearly beyond those of North American equipment.

.../2

APPENDIX A-13

COPY

With 72 units the Weenusk project would be a high-profile large-scale demonstration that would facilitate your Canadian market penetration as well as being the most appropriate technology for this particular project. The stove was enthusiastically received by Mr. Jenkins, but the right price is of importance. For the purposes of this project, the limited resources and large scale application hopefully will keep the price as reasonable as possible.

There are details of logistics and management to be worked out, for which, of course, we will comply with your requirements. Our suggestion is the following scenario.

1. Delivery of units by Rayburn to Toronto.
2. Site engineering by Allen Associates with approval by Rayburn (eg. approved shop drawings, specifications).
3. Delivery of units from Toronto by project coordinator.
4. Installation would be performed by an appropriate Canadian contractor.
5. All installations would be commissioned by an authorized person, likely a staff member of Rayburn.

With the above scenario in mind (or one you might suggest) we would like to request specific pricing information for the following items with a unit cost breakdown (to be used for the Weenusk Project only):

1. Rayburn Royal (solid fuel) stove, gravity feed tank, special plumbing fixtures. Please refer to schematic for our concept of the pressurized domestic hot water delivery/gravity heat transfer loop. A pressurized hot water system is considered appropriate since the housing is only one storey high, and sufficient gravity pressure would not be generated at the taps. Costs quoted are to be at Toronto F.O.B.
2. Commissioning services by authorized Rayburn staff.

For further general background for the Weenusk project, please contact:

Mr. Jeremy Jenkins
Shelter Ltd.
9 Lakeshore Drive
Toronto, Ontario M8Y I9Y

Phone No: (416) 251-2115

Page 3
Mr. Gordon Flagler
July 10, 1986

COPY

If you have questions regarding mechanical system design and implementation, please feel free to contact us anytime.

Your efforts are very much appreicated in advance.

Yours sincerely,

Mario Kani

Mario Kani, P. Eng.

MK:mo
encl.

cc: Jeremy Jenkins, Shelters Ltd.

COPY

APPENDIX A-15

MECHANICAL AND ELECTRICAL EQUIPMENT FOR THE WEENUSK BAND, PEAWANUCK, ONTARIO

These recommendations are based on the desirability of minimizing electrical energy demand without compromizing convenience, durability, or servicebility. Wood heating is clearly the prefered option for space heating and may also be used to provide domestic hot water and cooking. Other energy uses addressed include lighting, heat distribution, ventilation, and refrigeration.

SPACE HEATING

Forced air distribution requires approximately 300 watts of fan power which could consume 1500 kWh/yr at a cost of $525.00/yr at $.35/ kWh. Hydronic heating could be gravity circulated but is subject to freeze damage and requires elaborate plumbing. The preferred distribution is natural convection and radiation.

A wood heater supplying heat to the basement radiantly, will warm surrounding surfaces which, in turn, will heat the air. Warm air convecting to the ceiling, will elevate the temperature of the upstairs floor providing radiant heating above. With floor temperatures 5°C above the upstairs air temperature, the rate of heat delivery is about 5 kW.

Vent openings to rooms above of approximately 1 ft^2/room will provide an additional 1.5 kW heating to upstairs with basement ceiling temperatures 5° above the upstairs air temperature. In order to ensure the stairwell acts principally as an air return and other openings as supplies, it is necessary to provide a skirt below the opening of about 6 to 8". Note that if the basement ceiling is finished, radiant heat transfer will be returned requiring higher basement temperatures to heat the upstairs. This may be somewhat improved by forming a continuous plenum by strapping the ceiling and providing a large vent opening above the wood stove to permit warm convected air to flow above the ceiling.

An enclosed console-type wood heater is not recommended as they are generally less efficient and will not provide uniform conditions in the basement and hence upstairs. A suitable Canadian wood stove is available from Lakewood Stove Co. Ltd., Box 489, Lakewood Crescent, Bobcaygeon, Ont. KOM 1A0 (705) 738-3883.

VENTILATION

Prerequisites of the ventilation system are:

1. adequate air change is provided to maintain good air quality and moisture control
2. fresh air is introduced in a manner that avoids thermal discomfort.
3. fresh air is well distributed
4. adequate combustion air is provided and the system will not cause backdrafting of flues.
5. the indoor pressure is neutral or slightly negative with respect to outside to avoid induced moisture flow into wall and roof cavities.

COPY

During the winter, wood stove operation is probably adequate to provide most ventilation requirements provided there is sufficient envelope leakage which is likely with operable windows. However, there may be noticible cold drafts and kitchen and washrooms will periodically experience high moisture loading resulting in heavy window condensation mould and deterioration. In addition, smoking and other occupant activities may require greater air change to maintain good air quality particularly when wood heating is not required. It is therefor, recommended that a balanced forced ventilation system be installed to be operated continuously on low speed with manual and dehumidistat controlled high speed operation. A high effieciency heat recovery ventilation system with proven defrost operation should be installed not only to minimize heating load but to sufficiently preheat make-up air that it may be discharged without creating discomfort.

Because the electrical load of continuously operated fans can be sustantial (2@75 watt blowers consume 1300 kWh/yr costing $460/yr), low wattage fans are preferred. The recommended unit is an Air Changer DR 150 equipped with a pressure balance kit which permits exhaust air to return to space when the house experiences negative pressures thereby ensuring adequate combustion air.

cost: unit + ducts = $1300.
+ installation

The manufacturer's instructions prescribe installation design. Fresh air is preferably delivered at the top of the stairwell to avoid local drafts and the possibility of occupants sealing the outlet.

The primary difficulty with a low efficiency site-built HRV system as installed in Armstrong, is that without a forced air system, the cold make-up air cannot be readily discharged without cold air pooling or drafts.

ELECTRICAL SERVICE

For these dwellings, the Ontario Electrical Code would size the service, if all electric, as follows;

Basic service	6000 W
Range	6000 W
Space Heating - appox.	8000 W
Hot Water Heating (3000 W)	750 W
	20750 W

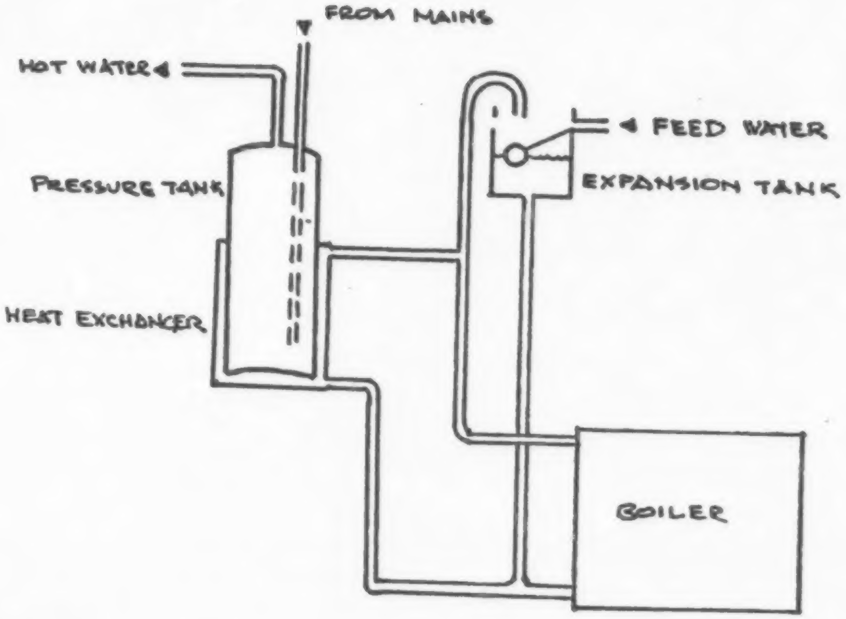
This corresponds to 94 amps @ 220 V.

If we assume that all cooking, space heating and hot water heating is done with wood and energy efficient lighting is used, a basic service of 4000 W or 18 amps could be assumed. If 20 amps are available it is possible to use a hot plate (1500 W) but it is clear that both an electric range and hot water heating are not feasible.

COOKING AND DOMESTIC HOT WATER HEATING

Load and power demand of cooking and DHW heating make electric supply unatractive due to service entry restrictions. Wood heating is clearly preferred.

The Rayburn Regent combination cookstove and boiler, manufactured and used extensively in Great Britain, is well suited for this application. It is insulated for efficiency, performance, compact installation, and summer usage with even the top plate equipped with close-down insulating covers. It has a built-in boiler heat exchanger for supplying hot water to a domestic hot water tank by gravity



DOMESTIC HOT WATER PLUMBING

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circulation. The rugged cast iron construction is capable of enduring the rigors of shipping and heavy usage.

The units are relatively expensive exceeding $ 5000 delivered and entail complicating logistics such as approval procedures, qualified installation inspections, etc. but appear to be the best alternative available.

Domestic hot water heating requires open vented gravity pressure plumbing on the boiler loop in order to permit boiling without risk of pressure failure. This requires a heat exchanger storage tank located above the wood stove of approximately 30 gallons storage and an open vented feed water and expansion tank on the boiler circuit as illustrated.

ENERGY EFFICIENT LIGHTING

To free up electrical demand for other uses (e.g. power tools) fluorescent lighting can be used throughout the house. The 18 W, 4½ "ϕ Globulescent fits into standard screw mounts and is equivalent to a 60 W incandescent bulb. As fluorescent fixtures do not work at sub-freezing temperatures it is suggested that two 25 W incandescent lamps be placed, one in the kitchen and one near the wood stove in the basement, in case the space heating has been left off for some time. If there are one or two outdoor lights these are recommended to be tungsten halogen flood lamps. The ordering details are as follows:

Indoor: Type Globulescent
Manufacturer/Distributor: Spectro Electric Industry Inc.
1399 Kennedy Road
Contact. H.L. Schmidt / Scarborough, Ont. M1P 2L6 751-3055

Outdoor: Type: Capsylite Flood Lamps 55 PAR/FL/SS
Manufacturer/Distributor: GTE Silvania Canada Ltd.
35 Vulcan Street M9W 1L3 247 6171

REFRIGERATION

At this point it is unclear what the exact needs for refrigeration/freezing are. It seems to us that most of the food will be frozen rather than refrigerated. Ideally, the refrigeration equipment would have equal refrigerator and freezer comparments. It is possible to stack two small front opening units; however, there may be a cost penalty. The most efficient standard size units are:

Refrigerator: Kenmore 86421?0 (12 cuft. top freezer)
Same Kenmore 86311?0 (11 cuft. no freezer)
Freezer: woods E 461 (16.5 cuft. chest)

Note:? denotes digit that changes according to style and colour.

3.8

John Gulland
Energy Pathways
Ottawa and Killaloe, Ontario
(613) 757-3144

John Gulland was well informed about the type of stove required in a remote location and his comments and recommendations of stoves were very beneficial.
He did not feel the 2 level house would cause a safety problem as Cal Wallis did and felt the heat distribution in such an arrangement could be accomplished satisfactorily.

He had experience with hot water heating systems and did not recommend that we try any available system due to the maintenance problems.
His stove recommendations were for thick steel, single shell basic box airtight heaters, with or without firebricks. He did not feel energy efficiency was a major consideration if you were to use one of these types of stoves, that is to say the difference between them was not a consideration.

The stoves recommended were the Lakewood Cottager or Lakewood Unicorn if a larger firebox was needed, The Cartier-1 by Heritage which was good except for the top which has only 11" of flat area as a heating surface for pots , and the The Elmira 900 and 1100, although quality was a concern with these. He also recommended the Krupa cookstove instead of the Elmira, however as previously mentioned, we could not get any for delivery.

We did try the Lakewood Cottager and many of the Heritage stoves as a result of this recommendation.

3.9:

Don Beugler
CMHC Research Division
Montreal Road,
Ottawa , K1A 0P7
(613) 748-2658

Mr.Beugler was consulted regarding the possibility of backdrafting of the wood stove due to pressure differentials within the house caused by a lack of draft of the stove and depressurization caused by the exhaust fans. This backdrafting causes smoke and carbon monoxide to spill back into the house rather than going up the chimney, particularly whenever the stove is only smouldering and not under full fire. He has a computer program to simulate these pressure differential conditions within the house.

We gave him the specifications on the proposed house and stoves and he did a simulation on the computer, with the following results: The stove being in the basement is an advantage since it has better draft due to the long, straight flue, and he felt there would **not** be any backdrafting problem. It did not make any difference whether the outside air was cold or moderate temperature since we were using the best 2100° insulated chimney.

With both exhaust fans running, there should not be any problem, however due to inefficiencies in his calculations, it would be necessary to confirm the predictions in the actual houses. If the house was as airtight as 1 airchange at 50 pascals there could be some backdraft only when the fire was just smouldering. But the houses were not built as tight as that, and the heat exchanger has an intake for air to allow incoming air to balance the pressure anytime that an inside fan is turned on. The test which would be performed would be to monitor the carbon monoxide level in the house, and if there was no CO then this would confirm that there was no backdrafting problem.

To date, the carbon monoxide monitors have detected zero carbon monoxide in any of the houses, so it is safe to assume that there is no backdrafting occuring.

3.10: Bob Topp,
McDairmid Lumber
600 Pembina Highway,
Winnipeg, Manitoba, R3M 3S3
(204) 452-2233

McDairmid Lumber was the main supplier of building materials for the construction of all the buildings in the new town of Peawanuck. They also supply materials and equipment to many isolated communities throughout northern Manitoba and Ontario, and have extensive knowledge in heating systems for these applications.

They sold several brands of woodstoves, mostly of the simple airtight steel variety that were recommended by so many.
The stove that they recommended above all others was the Selkirk Ranger due to its ruggedness, large size and flat top for heating water pots.
Our main concern about this stove was that it would be too large and overheat the houses, thereby causing the occupants to burn the stove slowly, which in turn causes excessive creosote buildup. The stove had a firebrick lining which had to be installed and maintained by the owner, and as well, this stove was about 35% more expensive than the Heritage or other simple steel stove.

However, from all accounts by the local people, they were very popular and had been used in other communities. In total, 15 of these stoves were ordered and installed in Peawanuck and 2 are being monitored as a part of this study.

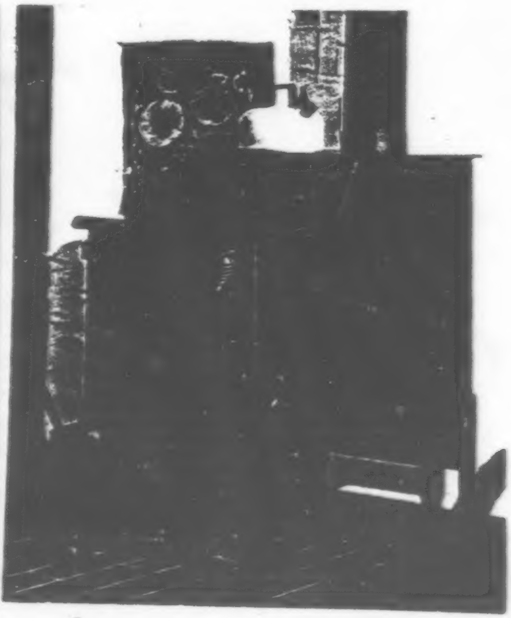
RANGER

Featuring old-fashioned charm with modern wood stove technology. Ranger's steel plate construction gives excellent radiation while using heat exchanger tubes to maximize the heat output coming from the stove.

Refractory lining on all sides of the large capacity firebox (30" long, 14" wide, 18" high) ensures a hotter fire over longer periods — you get all the heat you need from the fuel you burn, no matter if it's wood or coal.

Rotating draft control knobs to adjust burn rate, pre-heated secondary air tubes, fan kit, and a two-position door latch for rapid chimney priming are but a few additional features that make Ranger the ideal stove for large open areas or furnace backup.

The Ranger is listed by Underwriters Laboratories of Canada.



SELKIRK METALBESTOS
130 North Augusta Road, Brockville, Ont., K6V 5V3

3.11:

Dan O'Leary
CMHC, Project Implementation Div.
Montreal Road, Ottawa, Ont. K1A 0P7
(613) 748-2502

Dan O'Leary works in the Rural and Native housing demonstration group at CMHC and has much experience in the remote housing field. He introduced me to Don Beugler and discussed some of his ideas on wood heating. He suggested the use of a wood furnace rather than a woodstove because of the heat distribution problems, but suggested vents through the floor if a woodstove was used on the lower level. If water was installed in the house there would need to be a backup heat source for the wood in case the owners went away for any extended period of time.

He acknowledged that a wood-water heating system is very complicated and has not been developed to the state where it should be used in a remote location due to the possible maintenance problems which would be difficult to solve under normal circumstances, but impossible to deal with in an isolated community.

3.12:

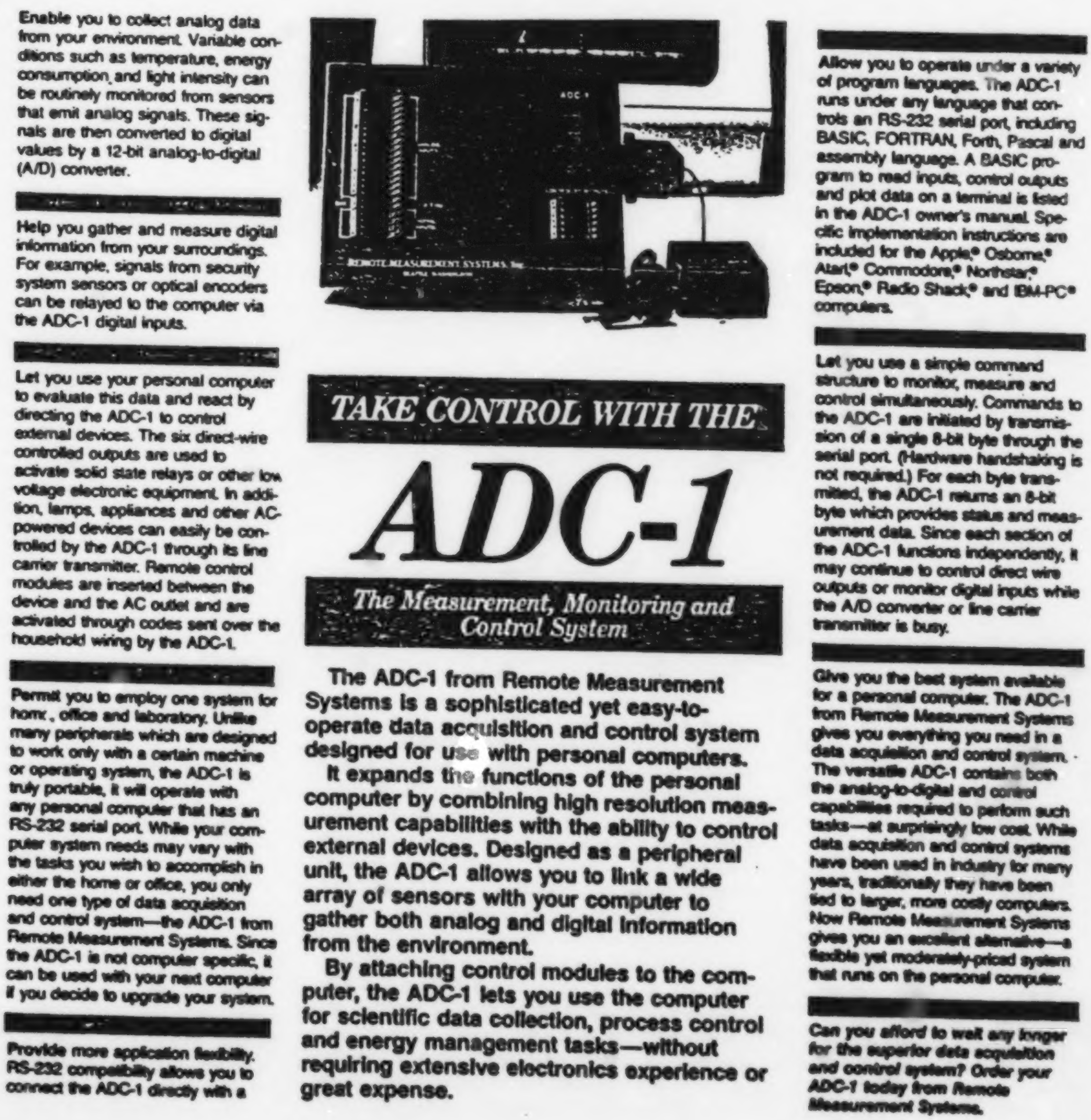
Ted Kesik
Habitechnica
102 Walmer Road,
Toronto, Ontario, M5R 2W6
(416) 978-5964

Ted Kesik is an engineer who does work on the engineering design and monitoring of energy efficient, particularly R-2000 houses.
We spoke to him regarding the monitoring of the houses in this project in Peawanuck.

He recommended that the monitoring be done for a period of only one month since that would provide adequate information for the results desired, particularly in light of the use of wood, which is difficult to accurately calculate what heat is really being supplied into the house.

For the actual monitoring, he recommended an electronic measurement system called the ADC-1 manufactured by Remote Measurement Systems Inc. of Seattle, Washington.

Since EMR had hygrothermographs available for our use in monitoring the project, it was decided not to persue this automatic system, however it appears to be an excellent product and may be useful in some future project.


ADC-1
REMOTE MEASUREMENT SYSTEMS, Inc.

Enable you to collect analog data from your environment. Variable conditions such as temperature, energy consumption and light intensity can be routinely monitored from sensors that emit analog signals. These signals are then converted to digital values by a 12-bit analog-to-digital (A/D) converter.

Help you gather and measure digital information from your surroundings. For example, signals from security system sensors or optical encoders can be relayed to the computer via the ADC-1 digital inputs.

Let you use your personal computer to evaluate this data and react by directing the ADC-1 to control external devices. The six direct-wire controlled outputs are used to activate solid state relays or other low voltage electronic equipment. In addition, lamps, appliances and other AC-powered devices can easily be controlled by the ADC-1 through its line carrier transmitter. Remote control modules are inserted between the device and the AC outlet and are activated through codes sent over the household wiring by the ADC-1.

Permit you to employ one system for home, office and laboratory. Unlike many peripherals which are designed to work only with a certain machine or operating system, the ADC-1 is truly portable, it will operate with any personal computer that has an RS-232 serial port. While your computer system needs may vary with the tasks you wish to accomplish in either the home or office, you only need one type of data acquisition and control system—the ADC-1 from Remote Measurement Systems. Since the ADC-1 is not computer specific, it can be used with your next computer if you decide to upgrade your system.

Provide more application flexibility. RS-232 compatibility allows you to connect the ADC-1 directly with a

TAKE CONTROL WITH THE

ADC-1

The Measurement, Monitoring and Control System

The ADC-1 from Remote Measurement Systems is a sophisticated yet easy-to-operate data acquisition and control system designed for use with personal computers.

It expands the functions of the personal computer by combining high resolution measurement capabilities with the ability to control external devices. Designed as a peripheral unit, the ADC-1 allows you to link a wide array of sensors with your computer to gather both analog and digital information from the environment.

By attaching control modules to the computer, the ADC-1 lets you use the computer for scientific data collection, process control and energy management tasks—without requiring extensive electronics experience or great expense.

Allow you to operate under a variety of program languages. The ADC-1 runs under any language that controls an RS-232 serial port, including BASIC, FORTRAN, Forth, Pascal and assembly language. A BASIC program to read inputs, control outputs and plot data on a terminal is listed in the ADC-1 owner's manual. Specific implementation instructions are included for the Apple,® Osborne,® Atari,® Commodore,® Northstar,® Epson,® Radio Shack,® and IBM-PC® computers.

Let you use a simple command structure to monitor, measure and control simultaneously. Commands to the ADC-1 are initiated by transmission of a single 8-bit byte through the serial port. (Hardware handshaking is not required.) For each byte transmitted, the ADC-1 returns an 8-bit byte which provides status and measurement data. Since each section of the ADC-1 functions independently, it may continue to control direct wire outputs or monitor digital inputs while the A/D converter or line carrier transmitter is busy.

Give you the best system available for a personal computer. The ADC-1 from Remote Measurement Systems gives you everything you need in a data acquisition and control system. The versatile ADC-1 contains both the analog-to-digital and control capabilities required to perform such tasks—at surprisingly low cost. While data acquisition and control systems have been used in industry for many years, traditionally they have been tied to larger, more costly computers. Now Remote Measurement Systems gives you an excellent alternative—a flexible yet moderately-priced system that runs on the personal computer.

Can you afford to wait any longer for the superior data acquisition and control system? Order your ADC-1 today from Remote Measurement Systems.

APPENDIX **A-24**

3.13:

Rudolf Prell
Viessmann Mfg.Inc.
600 Weber St N.,
Waterloo, Ont., N2V 1K4
(519) 885-6300

Viessmann manufacture wood fired boiler heating systems, and were considered for the possibility of using the hot water for personal use as well as heating.

Due to the lack of experience with this type of system as well as the complexity of such a system, it was not used in Peawanuck.

VIESSMANN

Total Alternate Energy Flexibility Combined with Highest Efficiency and Superb Craftsmanship from the World's Largest Producer of Steel Boilers

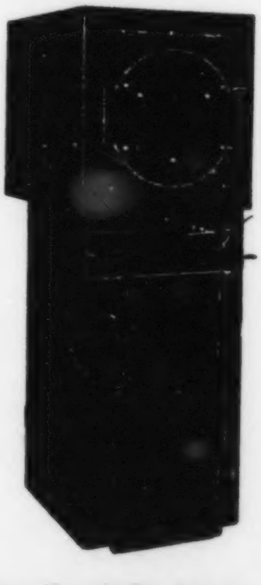
Mono-f boiler for wood and coal

4 sizes from 18 to 42 kW (62,000 to 145,000 btu/h)

Viessmann offers you sensible alternatives to conventional energy sources. It is now possible to greatly reduce oil and gas heating costs with the installation of either an "add-on" Mono-f boiler or entirely replace your existing boiler with a combination Mono-Vitola biferral-f boiler. Both boiler series offer many unique features such as:

- Compact design
- Large capacity solid fuel combustion chamber
- Corrosion free heating surface on combination unit when operating at low or modulating water temperatures with natural gas or light oil.
- Water cooled grates for solid fuel.
- Non electric temperature control for solid fuels.
- Attractive enclosure with heavy duty insulation

Mono-Vitola biferral-e boiler for oil, natural and propane gas and wood/coal

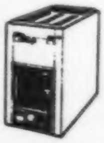
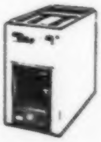
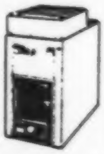
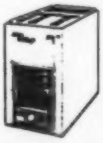


5 sizes from 18 to 42 kW solid fuels (62,000 to 145,000 btu/h)

3.14;

Victor Koby, President
Hunter Enterprises Lts.
P.O.Box 400,
Orillia, Ont. L3V 6K1
(705) 325-6111

Hunter Enterprises manufactures various types of wood burning furnaces as well as the Valley Comfort woodstove. Their wood furnace model HW80LD was considered as an all wood furnace with a full hot air ducted heat delivery system. Also they have a domestic water heater coil designed to connect into a hot water tank. This device cost only $100. and seemed to be a reasonable way to heat water, however they were not CSA approved and I could find no other person who had used them or would recommend them. Therefore these water heating devices were not ordered for installation at Peawanuck.

MODEL NO.	ADD-ON & OIL/GAS 801A 	INDEPENDENT WOOD 801B 	WOOD/ ELECTRIC 801CE 	ADD-ON TO OIL/GAS 201A 	INDEPENDENT WOOD 101B 	WOOD/ ELECTRIC 101CE
BTU Range Wood Electric	65,000–98,000	65,000–98,000	65,000–98,000 15 KW 49,200	100,000–160,000	100,000–160,000	100,000–160,000 20 KW 66,000
Height	45"	45"	54"	45"	45"	54"
Width	26¼"	26¼"	26¼"	26¼"	26¼"	26¼"
Length	31¼"	42⅛"	42⅛"	40¾"	53"	53"
Flue	7"	7"	7"	8"	8"	8"
Shipping Weight	395 lbs.	460 lbs.	510 lbs.	490 lbs.	590 lbs.	640 lbs.
Firedoor Opening	12×14	12×14	12×14	12×14	12×14	12×14
Hot Air Plenum	24⅛×29⅛	24⅛×25⅛	24⅛×25⅛	24⅛×39	24⅛×31⅛	24/⅛×31⅛
Cold Air Return	12×20	24⅛×13⅛	24⅛×13⅛	12×20	18¼×24⅛	18¼×24⅛
Blower	N/A	⅓ HP, 9" Sgle	⅓ HP, 9" Sgle	N/A	⅓ HP, 10" Sgle	⅓ HP, 10" 2 spd
Warranty on Firebox and Heat Exchanger	5 yr.	5 yr.	5 yr.	5 yr.	5 yr.	5 yr.
Oil Furnace Sizing	0.75 to 1.25	—	—	0.85 to 1.25	—	—
Firebox Height	20"	20"	20"	20"	20"	20"
Width	20⅛"	20⅛"	20⅛"	20"	20"	20"
Length	19¾"	19¾"	19¾"	28⅛"	28⅛"	28⅛"
Construction Frbox	8 GA	8 GA	8 GA	8 GA	8 GA	8 GA
Heat Exchanger	12 GA	12 GA	12 GA	12 GA	12 GA	12 GA

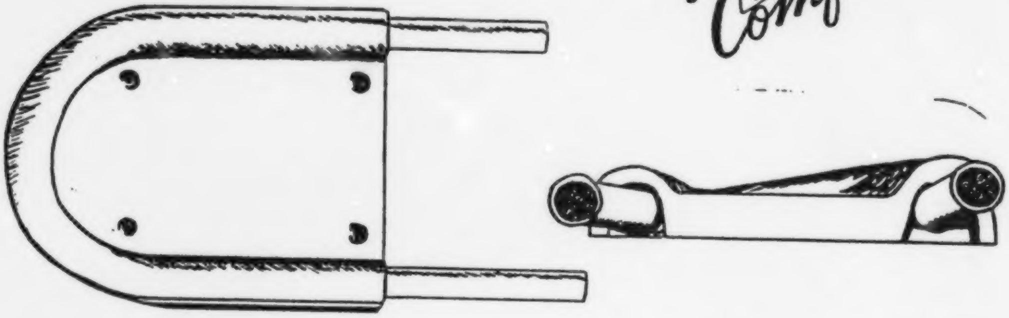
Victor Koby
President

Hunter

Hunter Enterprises Orillia Limited
P.O. Box 400 Orillia Ontario Canada
L3V 6K1
(705) 325-6111 Telex 06-875888

HEATER!

by Valley Comfort



DOMESTIC HOT WATER HEATER FOR YOUR WOOD/COAL STOVE or FURNACE

- WATA HEATER IS A DOMESTIC HOT WATER COIL DESIGNED TO REDUCE YOUR UTILITY BILL BY SUPPLING PRE-HEATED WATER FOR USE IN YOUR HOME SYSTEM
- HIGHLY CONDUCTIVE CAST ALUMINIUM HOUSING WITH MAXIMUM SURFACE AREA
- 3/4 " COPPER WATER PASSAGE FOR LESS FLOW FRICTION
- EASY INSTALLATION
- HEAVY DUTY CONSTRUCTION
- CAN BE USED IN CONJUNCTION WITH SOLAR SYSTEM
- BUILT IN SLOPE ALLOWS HORIZONTAL INSTALLATION
- VIRTUALLY NO MAINTAINANCE OR OPERATING COST ASSURES YEAR AFTER YEAR PAY BACK

Valley Comfort Systems Inc.
BOX 15, CRESCENT VALLEY, B.C.
CANADA V0G 1H0
Telephone: (604) 359-7296

Hunter
P.O. Box 400, Orillia, Ontario L3V 6K1 telephone 705/325-6111

3.15:

Steve MacAleese
Air Heat Supplies
760 Supertest Road,
Downsview, Ont., M3J 2M5
(416) 661-3794

Air Heat Supplies is a distributor for Olson furnaces, who manufacture wood and wood-oil combination furnaces. Their model CWF all wood furnace has its own air blower and is connected to a ductwork system which would run in the basement of the house for delivery of air up through dampers in the floor. The model CWOB 112 is a wood oil combination furnace again connected to a duct system delivering the hot air by a fan.

Due to availability and cost, these furnaces were selected for installation in the non residential buildings in Peawanuck.

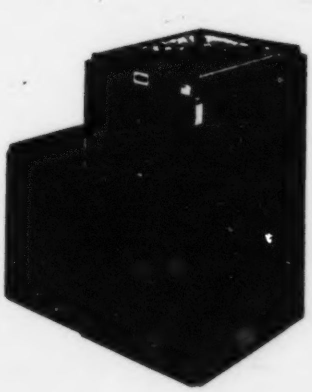
DUOMATIC OLSEN INC.

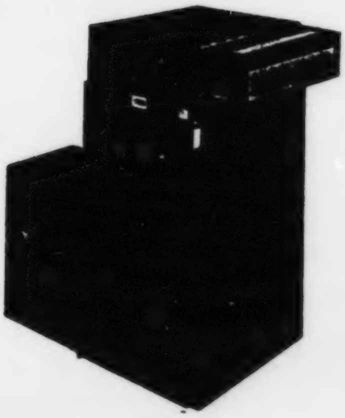
CENTRAL HEATING WITH . . .

WOOD
OR COAL

COMBINED
WITH ELECTRIC

Wood and Coal Fired Furnace
A free standing solid fuel furnace with it's own blower. If you have coal or firewood readily available, this is the ideal solution for reducing your heating costs. Save, and enjoy the advantages of a Forced Air System — Even Heat Distribution — and Automatic Thermostat Control.





Wood, Coal and Electric Combination Furnace
A top mounted electric heat section makes the CWF-E a versatile combination. The electric section stands guard and maintains your house temperature when you are asleep or away. If ever it is not convenient to burn solid fuel, the electric section can satisfy all of your heating needs. Operates on a separate thermostat.

3:16

Rob McMonagle, President
Prometheus Energy
7773 Yonge Street
Thornhill, Ontario, L3T 2C4
(416) 881-3369

Prometheus Energy import and distribute the Godin cookstoves which were considered as an alternative to the Elmira cookstoves. These stoves have a boiler which wraps around the stove and can be used for water heating. The specifications are enclosed.

We did not use one of these stoves, due to the untested nature of the product, particularly with regard to the water heating aspect, as well as the high cost of the stove, being $2400. per stove. Again as with all imports, particularly uncommon models such as these, the availability of service and parts was questionable.

WOOD/COAL

Ref. 5755: Traditionnal CUISICENTRAL – Black and shiny terra cotta.

H. 84/87 cm - L. 85 cm - D. 62.5 cm – Cast iron top plate - L. 100 cm - D. 65.5 cm - Towel rail round sides and front - L. 110 cm - D. 71.5 cm - Output 19.5 to 22 KW - Thermostat.

APPENDIX A-29

PROMETHEUS ENERGY

Solar Energy
Wood Energy
• Wind Energy
Energy Conservation

7773 Yonge St.,
Thornhill, Ont. L3T 2C4
(416) 881-3369

Shelter Limited,
ATTN: Jeremy Jenkins,
9 Lakeshore Dr.,
Toronto, Ont.
M8Y I9X

COPY

July 30, 1986

$2150. for 45 units.
300. for 1
Delivery 60-90 days

Dear Mr. Jenkins,

Greg Allen and Associates asked me if I could forward to you information regarding the Godin cook stove. Included are copies of the English general literature and the installation instructions (unfortunately only in French! English available when ordered).

Some of the features of the Godin cook stove Model 5755 are:

- the stove is thermostatically controlled
- the stove has a black enamelled finish (also available in a shiny terra cotta finish) with brass trim and towel rail around the sides and front
- the stove has a summer by-pass setting (less heat into the home but the same hot water and oven, stove top performance)
- the water heating is by a cast iron boiler plate which curves around three sides of the fire box. Connections are standard 3/4" threaded from the back of the stove

Need another water tank (40g) if Thermosiphon [illegible] tank above
pr. relief valve + drain valve

- the flue may be run off the top or the back of the stove, flue size is 5" - but may be adapted upwards to 6"
- clearance to combustibles is 18"
- dimensions are as follows:
    stove (h,w,d): 84 x 85 x 62.5 cm
    overall (h,w,d): 87 x 110 x 71.5 (rails and cook plates)
    firebox (h,w,d): 30 x 21.5 x 49 cm
    oven (h,w,d): 30 x 42 x 40 cm
- the stove is rated for heating (with wood) as follows:
    max. output 19.5 KW
    boiler output 15 KW
    radiated output 4.5 KW
- shipping weight is approximately 350 lbs. and would be available to be shipped from Toronto (or further east if the shipment is to go by water)

APPENDIX A-30

PROMETHEUS ENERGY

- Solar Energy
- Wood Energy
- Wind Energy
- Energy Conservation

7773 Yonge St.,
Thornhill, Ont. L3T 2C4
(416) 881-3369

COPY

- the stove has a three year warranty

- the stoves would be available in 60 to 90 days

I hope this gives you sufficient information if, however, you require any further information please do not hesitate to call me.

Yours truly,

Rob McMonagle
President

c.c. Greg Allen
Greg Allen and Associates
33 Madison Ave.,
Toronto, Ont.

RM:pp

APPENDIX B-1

Charles LeMay Inspection Report

March 6, 1987

COPY

William G. Peden
Regional Director, CREO Office
55 ST. Clair Ave. East
Suite 606
Toronto, Ontario
M4T 1M2

As promised, I am sending you a draft summary of my Peawanuck report. I would appreciate any comments you would to make on this report.

I. Objectives for first IRTA visit:

A. To ensure compliance of the installation of the stoves for the project with CSA B365 Installation Code.

B. To help in the setting-up of the monitoring program.

C. To recommend any course of action to ensure the safety of wood heating systems and the proper realization of the RCDP project in Peawanuck.

II. Action

A. Inspection of wood heating installation in Peawanuck

1. General observations

On march 2nd, 3rd and 4th, 15 heating installations were inspected for compliance with B365. Overall, the installation are well done. The installers have observed code requirement with few exceptions. Steps to correct of the installation errors have already been taken

Furthermore, the house occupants maintain a fairly clean area around the heating system. It is clear that most users have a long experience of wood heating. The wood being used is dry and is generally being burnt at a rate that maintains chimneys clean from creosote deposits.

What we found lacking was the assignment of the maintenance and information functions to a particular person designated to fill those tasks. We think that this can prove to be the weakest link in the safety chain. The corrections we will be suggesting should be assigned to a community person who takes on this responsibility. As he develops further knowledge in this field, he will be able to identify problems and recommend proper corrections, long after EMR's involvement in the community.

COPY

2. Particulars

a. Chimneys

We found no code infringements in the installation of the chimneys, for the part that was visible from the basement and the roof. The chimneys are of the proper type and are properly installed.

We examined a number of chimneys from the roof. None of those examined had large creosote deposits. Maintenance personnel should perform regular inspections of chimneys and clean them when necessary. Some installations will need more frequent inspections and cleaning than others.

We have found some operating problems with many of the chimneys: In very cold weather, ice forms around the caps and can restrict the proper flow of smoke. This is caused by the condensation of water from the combustion gases, on the chimney cap. Although the code prescribes the use of the chimney cap, we think that in this particular case, the cap becomes more of a danger than an asset. It should be removed, on a trial basis in all the houses where there is evidence of ice formation. Since part of the purpose of the cap is to ensure that rain does not penetrate in the chimney liner, it would be necessary to replace the cap as soon as winter is over.

Note: we have not removed panelling to inspect chimney clearances on the main floor. We have not inspected chimney installations in the attics.

b. Flue pipes (stovepipe)

(1) Clearances

All stovepipes had the proper 18-inch clearance from combustible materials. Homeowners should be informed of this requirement since it is often tempting to install clothes lines closer than this to permit more rapid drying. They should be warned against this.

(2) Materials and installation

Many of the stovepipes inspected did not have the required thickness. It seems that a number of "old" stovepipes were slipped into the order. We have found a good supply of these same pipes in one of the supply tents. Arrangements should be made to have all these stovepipes replaced.

Galvanized stovepipe should not be used with woodburning appliances. One of the stoves had a galvanized elbow. The wood-

OPY

oil furnace at the teacher's residence and the wood furnace at the Priest's residence both have galvanized stovepipes.

None of the stovepipes inspected had the proper three screws at all joints. It is important to have the sections screwed together. Most woodburners know from experience that snapped-on stovepipes have a tendency to reopen, especially when under undue inside pressure from the next pipe. This can cause the pipe to fall apart: a very undesirable situation when the stove is operating.

We opened stovepipes when the stove operation permitted. We found these stovepipes to be quite clean, whether this be from a recent brushing or from proper owner operation.

Although the present installation provides the shortest and straightest possible route for the stovepipe, we believe that branching off the appliance to a base tee would provide with a better situation for inspections. This would require moving the appliance a bit to one side to fit a tee in the stovepipe, under the chimney. This tee would be followed by a 90 degree elbow to connect the stove. A longer cap could be provided at the base of the tee to provide space for falling creosote. This cap could be easily removed for inspection, even if the appliance is being used. The present installation that use an adjustable collar can readily be removed but this cannot be done when the appliance is being used. This will favour procrastination: inspections will be put off indefinitely.

c. Stoves and furnaces

(1) Certification

All the appliances inspected had certification plates except one. This implies that all these appliances have been tested to basic safety standards developed by CSA and ULC. It is important to continue using only certified appliances in the houses in Peawanuck. If any of the occupants should decide that the stove they are presently using is unsatisfactory for their purposes, they should not replace these appliances with wood-fired tent heaters or other old, uncertified appliance.

The certification of the appliance without a certification plate should be verified. If it is not certified, the supplier should be asked to replace it by a certified unit, at his cost.

(2) Clearances to combustibles

In most homes, we found that the appliance was situated in a clear area in the middle of the basement. We have however found severe deficiencies that should be corrected as soon as possible. Fuelwood boxes were often place very close to the appliance. All

COPY

certified appliances have required clearances printed on a plate. on the side or the back of the stove. These clearances should be strictly adhered to. As soon as the final positioning of the appliance is reached, it would be a good practice to paint a white line around the appliance to show the occupants the proper clearances.

(3) Operating condition

Many of the units inspected had faulty or missing parts. Bricks were missing or improperly installed in Selkirk *** stoves. Many stoves had loose or ill-fitting gaskets. If the band had a roll of gasketting material and a few bottles of gasket glue these faulty gaskets could be replaced on the regular inspection by maintenance personnel.

One *** stove had missing hinge pins on the ash door. These pins had been replaced by nails of a much smaller diameter, leaving a one centimetre slit in the ash removal opening. This stove overheated and could not maintain a fire for a reasonable length of time. These pins should be properly replaced (two nails do not constitute a proper replacement).

The wood furnaces are not connected to a controlling thermostat. They are now being controlled manually by holding the combustion air damper open. Both furnaces were open wide enough to favour rapid combustion. This will help reduce creosote deposits but in the case of a furnace, this prevents the automatic high temperature shutoff to function. This means that if the plenum reaches dangerously high temperatures, the furnace has no means of shutting off the combustion air dampers. This could lead to the overheating of combustibles near the plenum and distribution ducts.

(4) Mounting

Since all the basement floors are of wood, all the appliances should be mounted according to the manufacturer's specifications. These specifications have been provided by the CSA testing of the appliance. Very often, the requirements are limited to the installation of a non combustible floor pad that extends 18 inches in front of the loading door and 8 inches on the other sides. None of the visited installation had the proper dimensions. It seems that arrangements have already been done to correct this situation. These pads should be replaced as soon as the new ones are in. We have found evidence of coals burning a hole in one of the floors already.

(5) Stove operation

Most stoves are operated fairly hot. This helps reduce creosote deposits in the chimneys and pipes. We have found a few

COPY

exceptions to this rule. What seems to help encourage hot operation is the fact that the appliances are located in the basements and the occupants must maintain a hotter fire to get the desired temperatures upstairs. In one case however, the occupants lived in the basement and maintained a smothering fire in their appliance (Lakewood cottager). This slow fire provided ample heat for their need. It is clear that this will increase creosote deposits since much of the smoke is not being burned. This particular installation should be monitored closely.

d. Safety Equipment

All wood burning installations should provide the maximum safety features. Among these features, some are required by codes and others are simply experience and common sense. Among the things that should be found are a poker, an ash shovel, a covered ash container. Most of these items were not present in the houses at the time of the visit. In one case, a cardboard box was being used as an ash container. This is a very dangerous practice and is known to have been at the origin of many house fires.

All houses should also have smoke detectors and a fire extinguisher. No house visited had fire extinguishers. On top of having a properly mounted fire extinguisher, it is important to have a maintenance person who will be responsible to have all the extinguishers inspected and maintained on a yearly basis. This would probably involve making arrangements with a qualified fire extinguisher maintenance person to come by plane once a year to perform these tasks, under the supervision of the local maintenance person.

Smoke detectors were found to be installed in a place where they are too sensitive. This causes the alarm to operate whenever a small amount of smoke escapes from the stove even when reloading. This can be frustrating for the occupant who may finally disconnect the detector, depriving himself and his family from an early warning in case of fire. It would be important to relocate the smoke detectors in order to render them a bit less sensitive.

e. Warm air distribution systems

(1) Furnace Ducts

The warm air and return air ducts for both wood heating furnaces have not been properly installed. On the warm air ducts, the main duct has proper clearances but the round distribution ducts come to zero clearance at a few inches from the plenum. This could be doubly dangerous since in both these cases, the high temperature switch is being bypassed by manual operation of the appliances.

COPY

The return air ducts for woodburning furnaces must not use the bare floor joists as conduits, as is permited in oil heating installations. A complete metal duct must be built, with prescribed clearances.

(2) Floor vents and open straircase

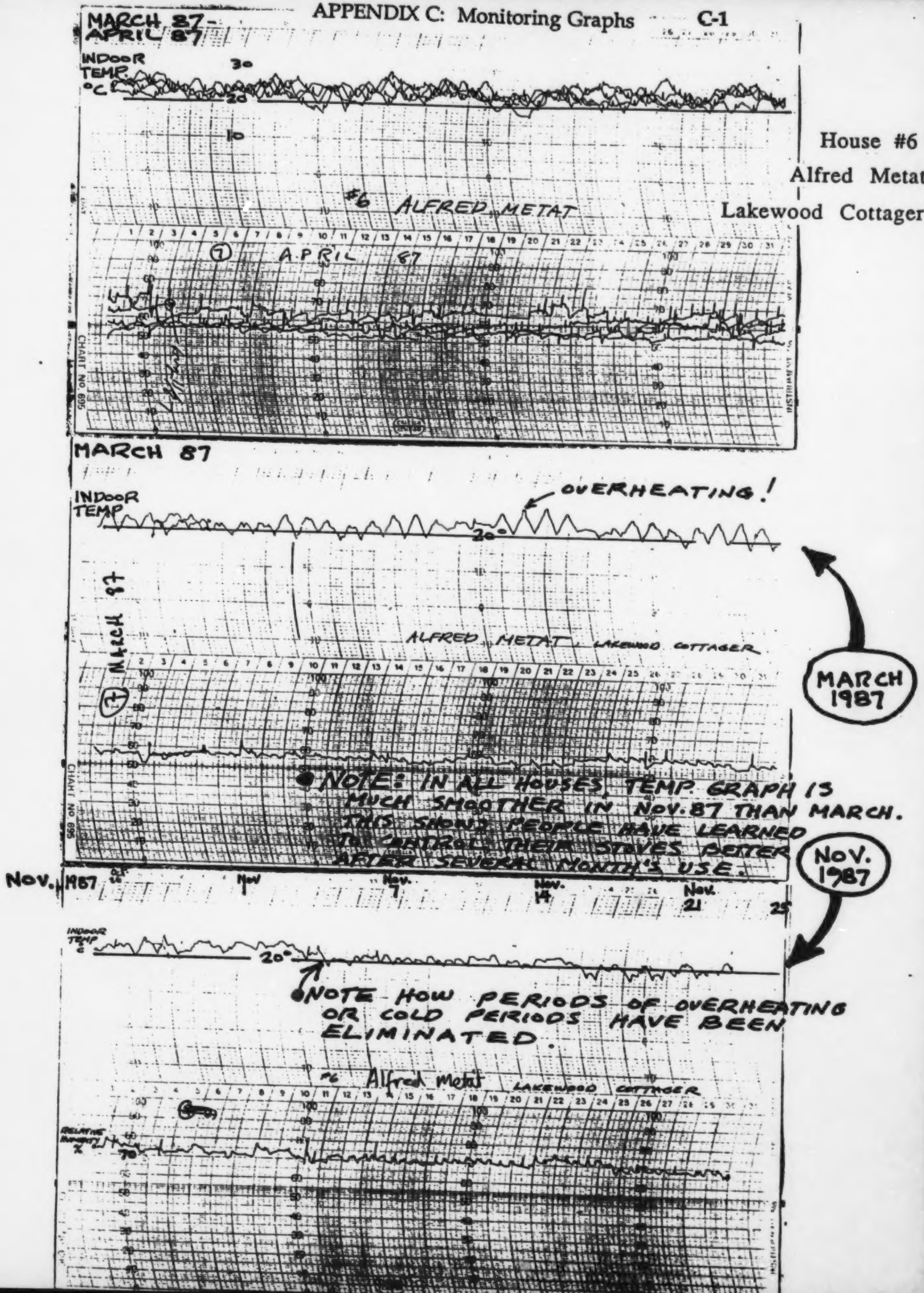
The fact that the stove is installed in the basement requires the free circulation of convection air in the house. This means that air must be allowed to freely flow in the stairwell. It also means that the air circulates better when floor vents are installed. It must be cautioned that these openings will also provide a faster spread of smoke and flames in the event of a house fire.

Charles LeMay (613)488-2618
IRTA
P.O. Box 250
Clarence Creek, Ontario
KOA 1NO

House #6

Alfred Metat

Lakewood Cottager



MARCH 87-
APRIL 87

#6 ALFRED METAT

APRIL 87

MARCH 87

OVERHEATING!

MARCH 87

ALFRED METAT LAKEWOOD COTTAGER

MARCH 1987

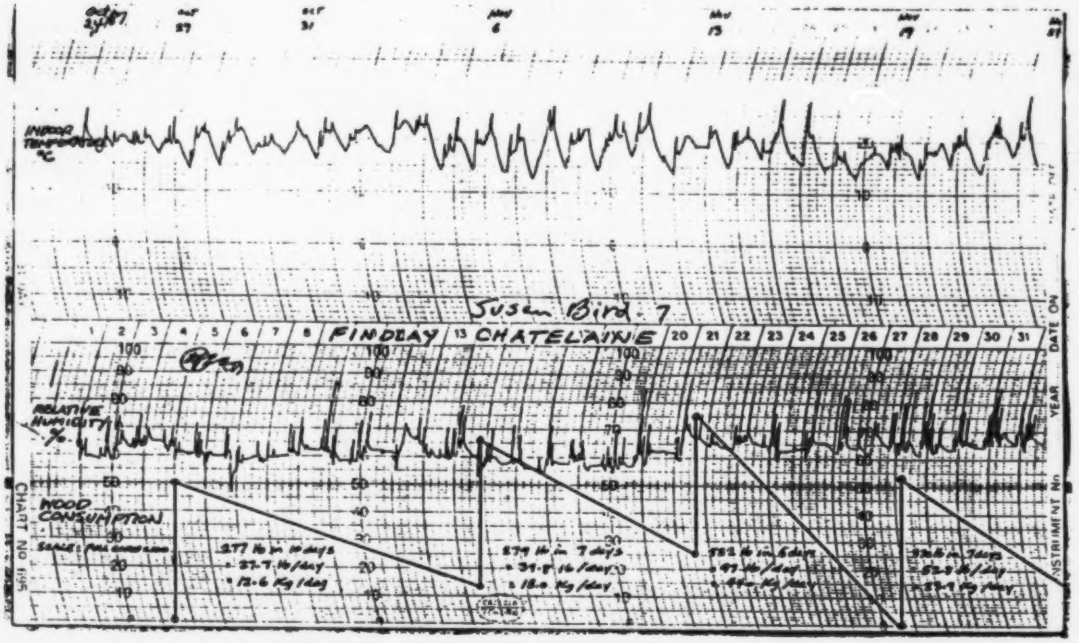
• NOTE: IN ALL HOUSES, TEMP. GRAPH IS MUCH SMOOTHER IN NOV. 87 THAN MARCH. THIS SHOWS PEOPLE HAVE LEARNED TO CONTROL THEIR STOVES BETTER AFTER SEVERAL MONTH'S USE.

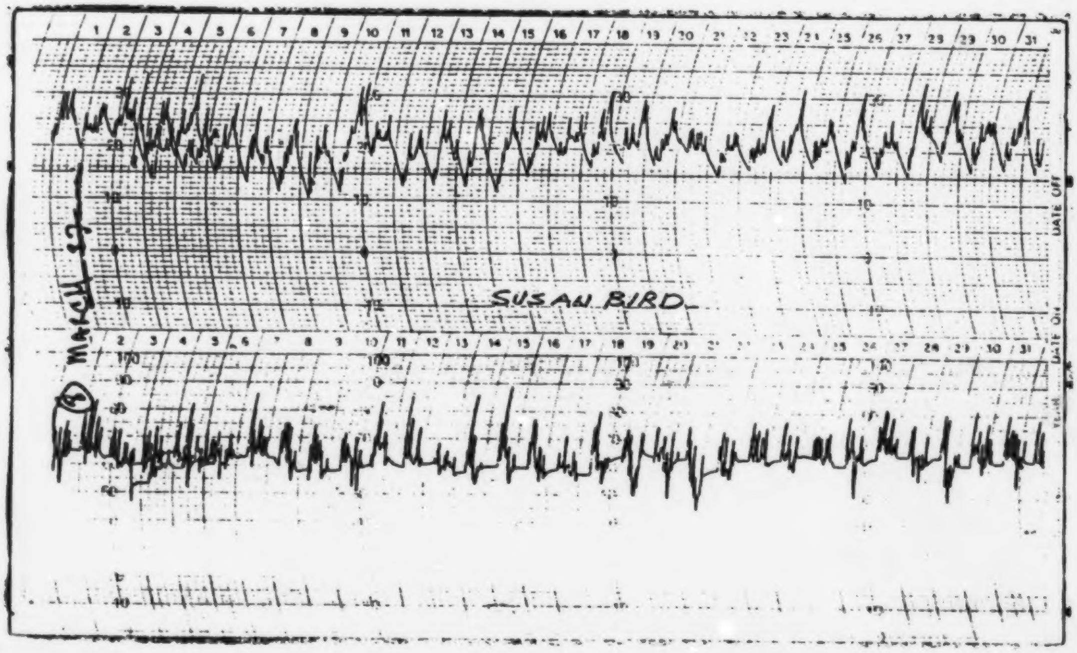
NOV. 1987

• NOTE HOW PERIODS OF OVERHEATING OR COLD PERIODS HAVE BEEN ELIMINATED.

#6 Alfred Metat LAKEWOOD COTTAGER

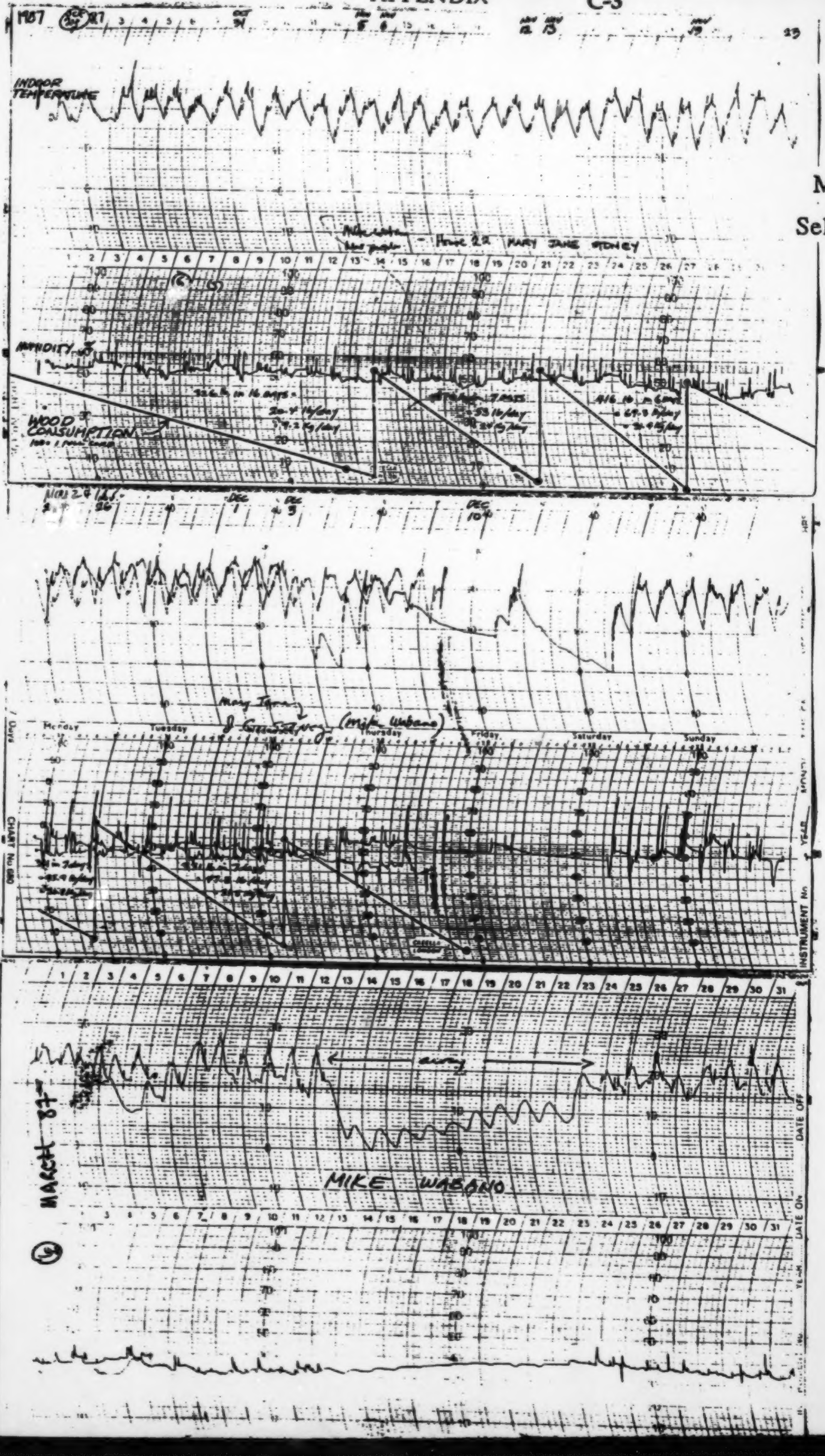
House #7
Susan Bird
Chatelaine



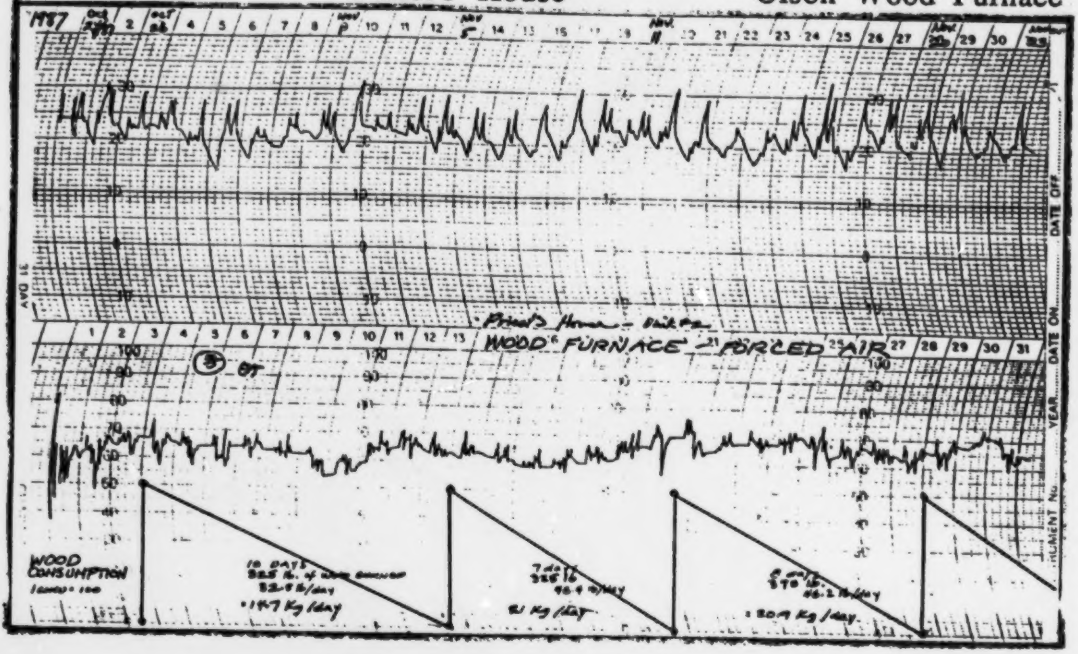


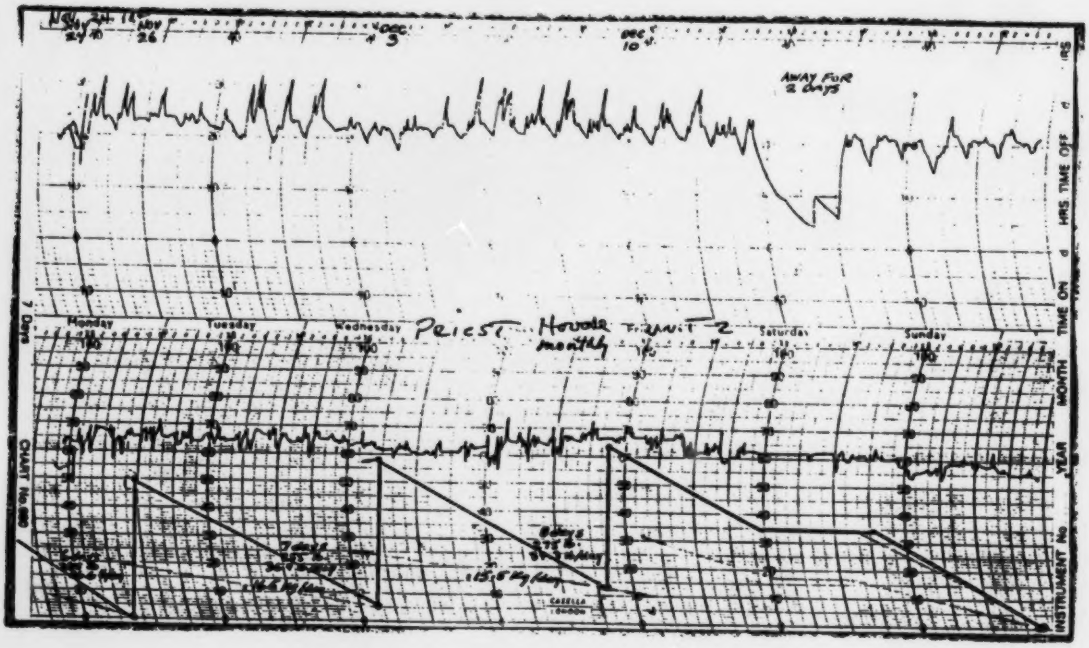
APPENDIX C-3

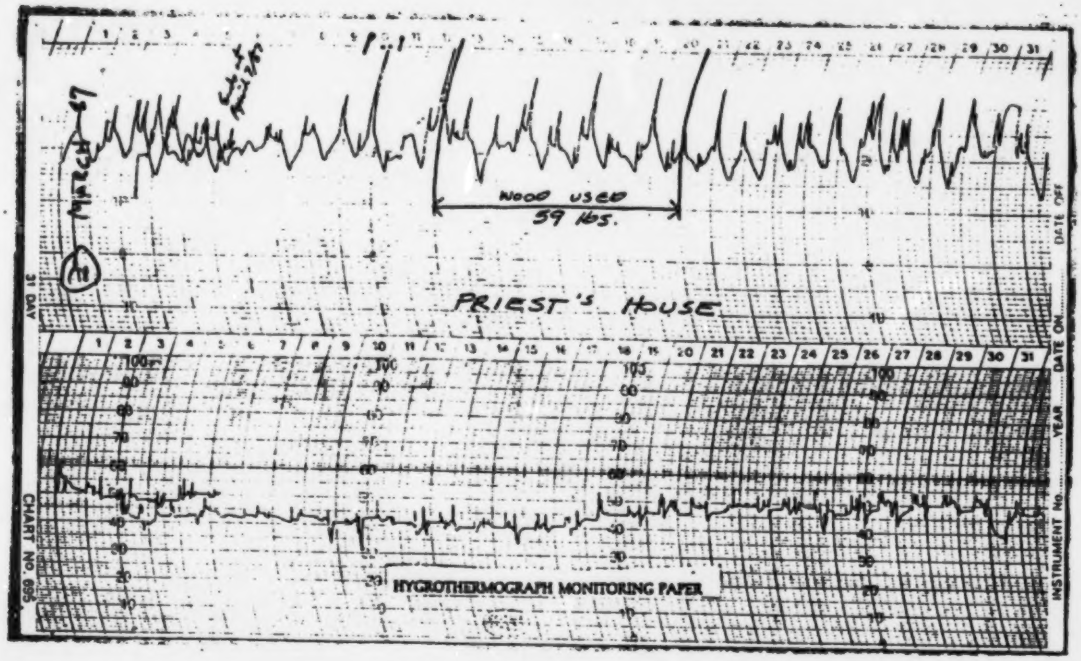
House 22
Mike Wabanc
Selkirk Ranger

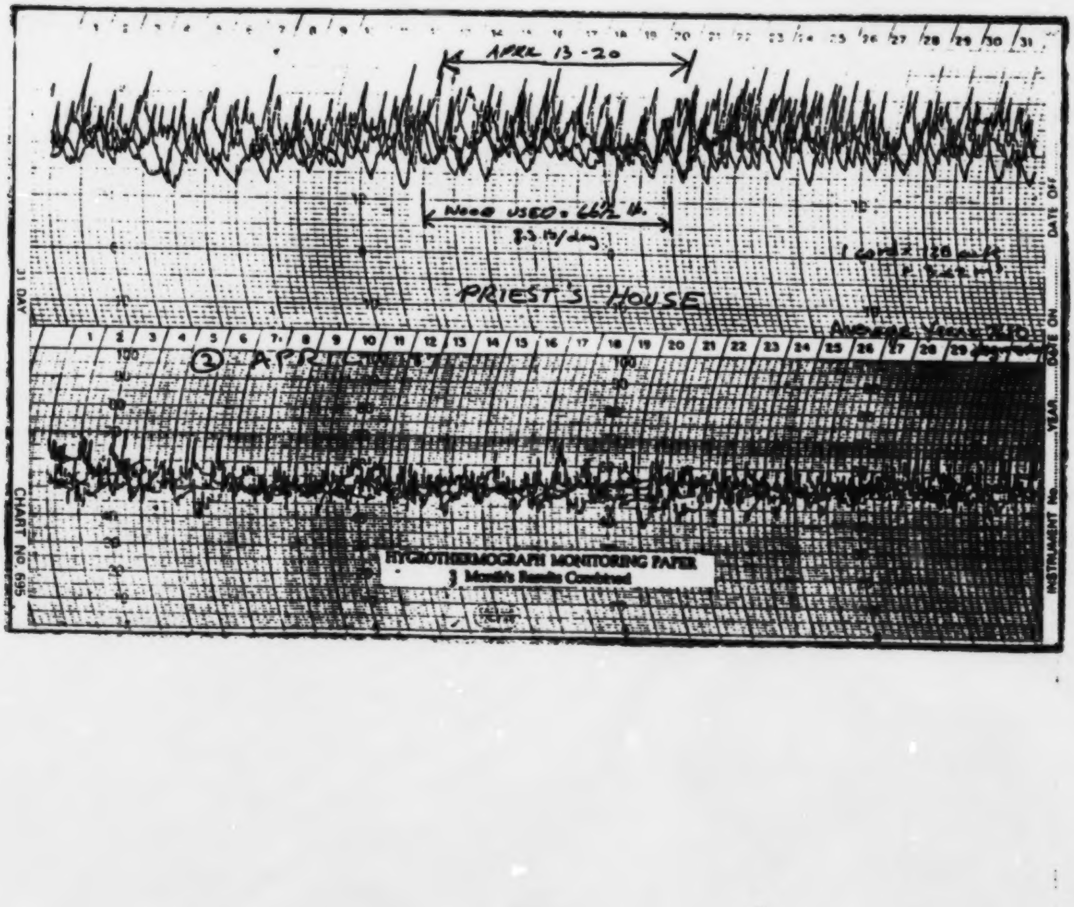


House 23 **Priest's House** **Olson Wood Furnace**

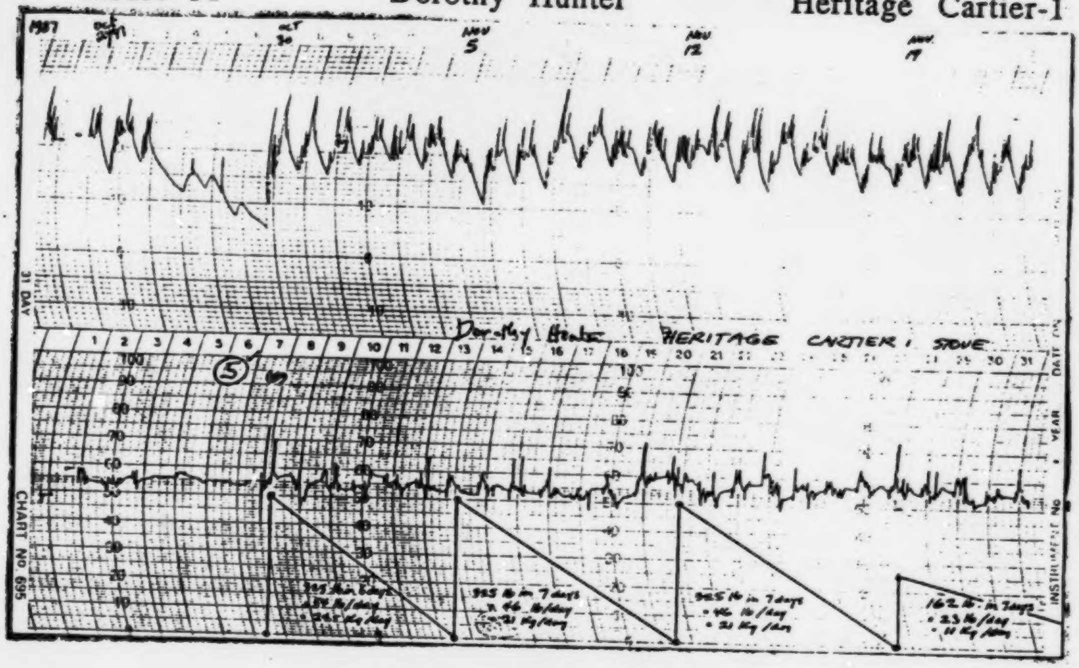


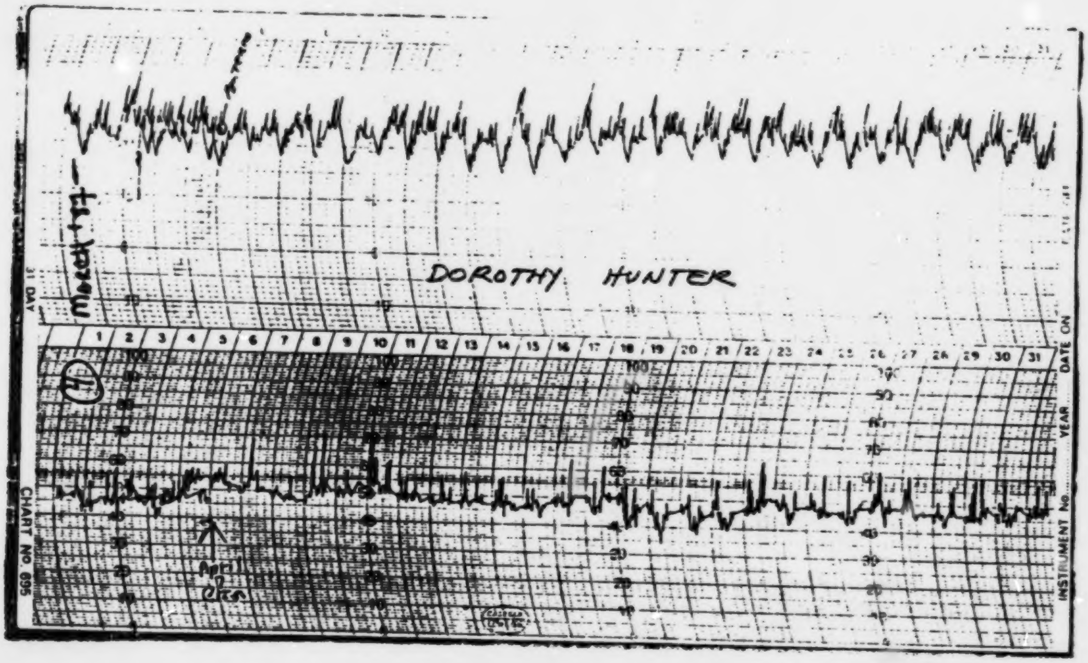



MARCH 87
WOOD USED
59 lbs.
PRIEST'S HOUSE
HYGROTHERMOGRAPH MONITORING PAPER
CHART NO. 695
31 DAY
INSTRUMENT No.
YEAR
DATE ON
DATE OFF


APRIL 13-20
WOOD USED = 66½ lb.
8.3 lb/day
1 cord = 128 cu. ft.
PRIEST'S HOUSE
Average Year = 360
② APRIL
HYGROTHERMOGRAPH MONITORING PAPER
3 Month's Results Combined
CHART NO. 695
31 DAY
INSTRUMENT No.
YEAR
DATE ON
DATE OFF

House 31 Dorothy Hunter Heritage Cartier-1

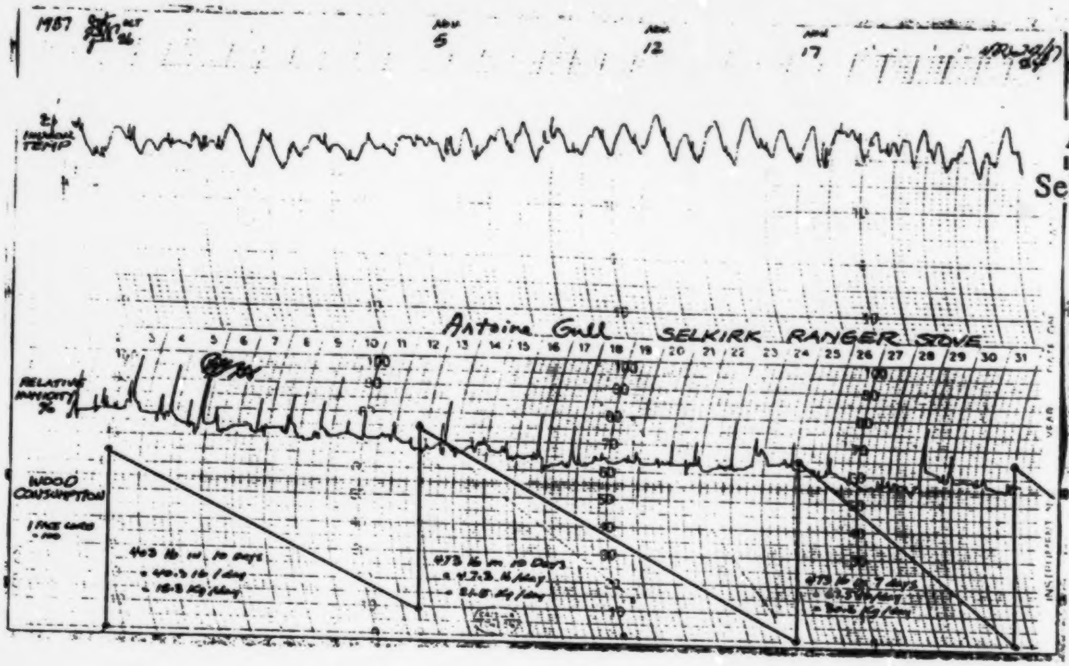


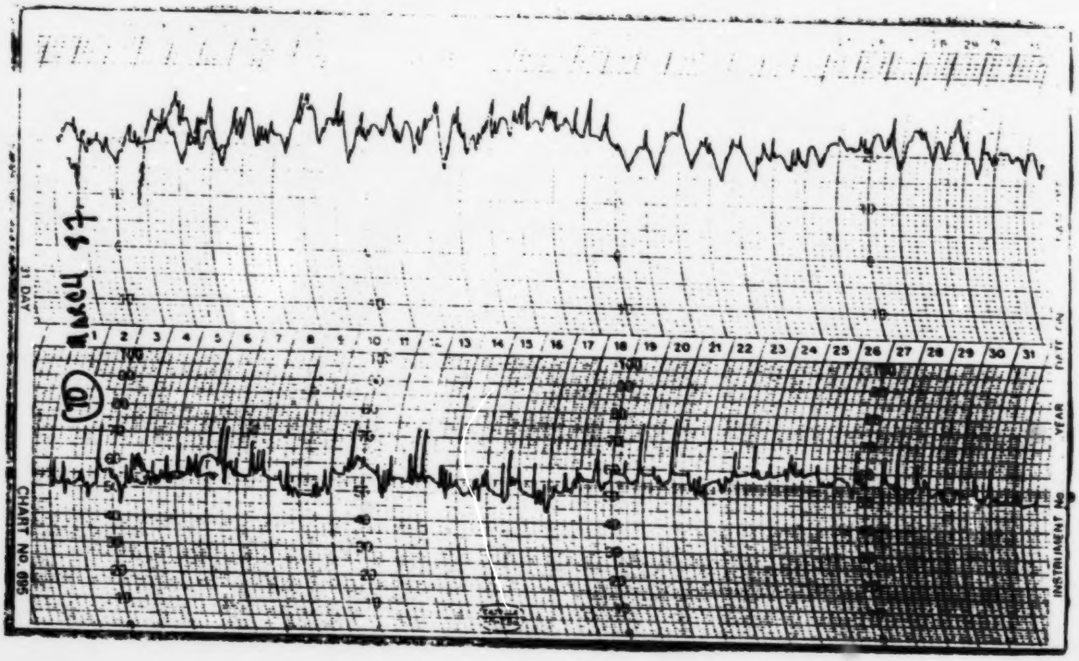


House 77

Antoine Gull

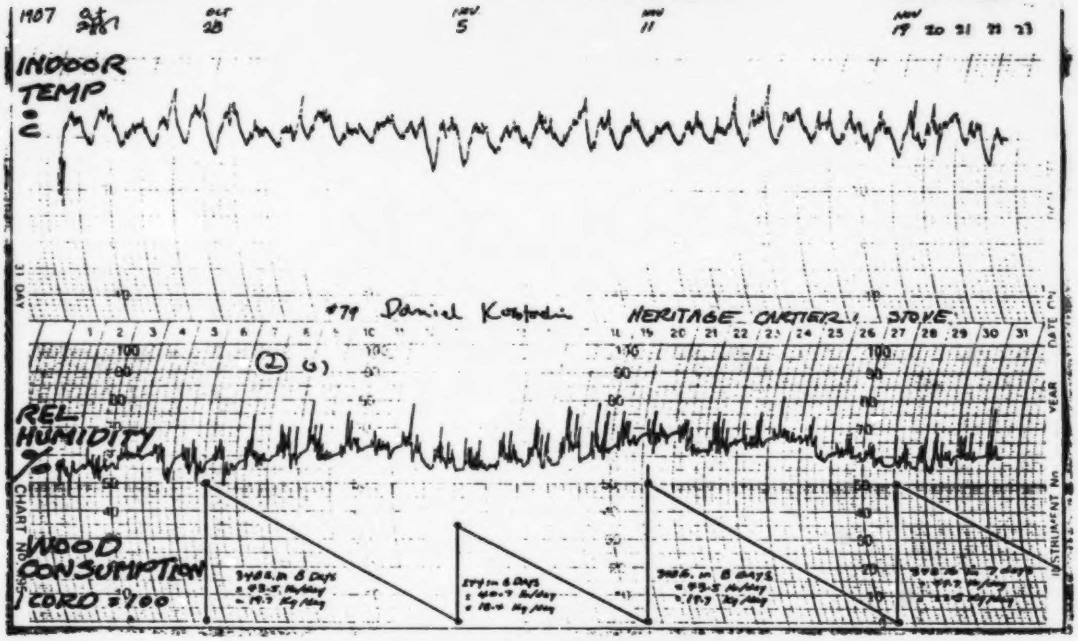
Selkirk Ranger





APPENDIX C-8

House # 79 **Daniel Koostachin** **Heritage**

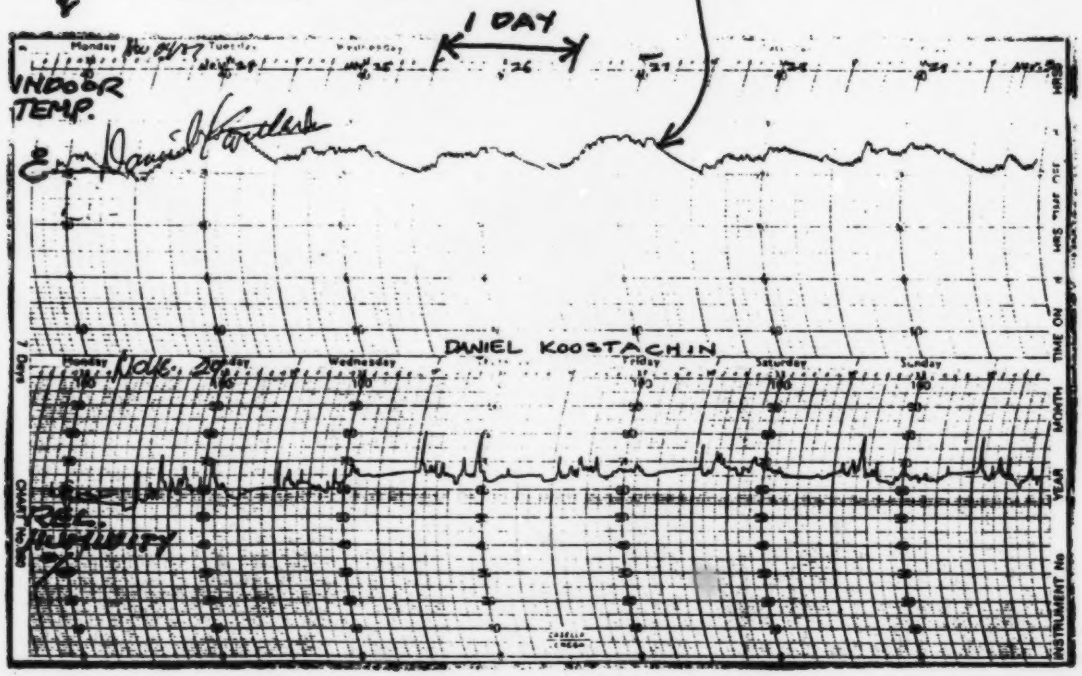


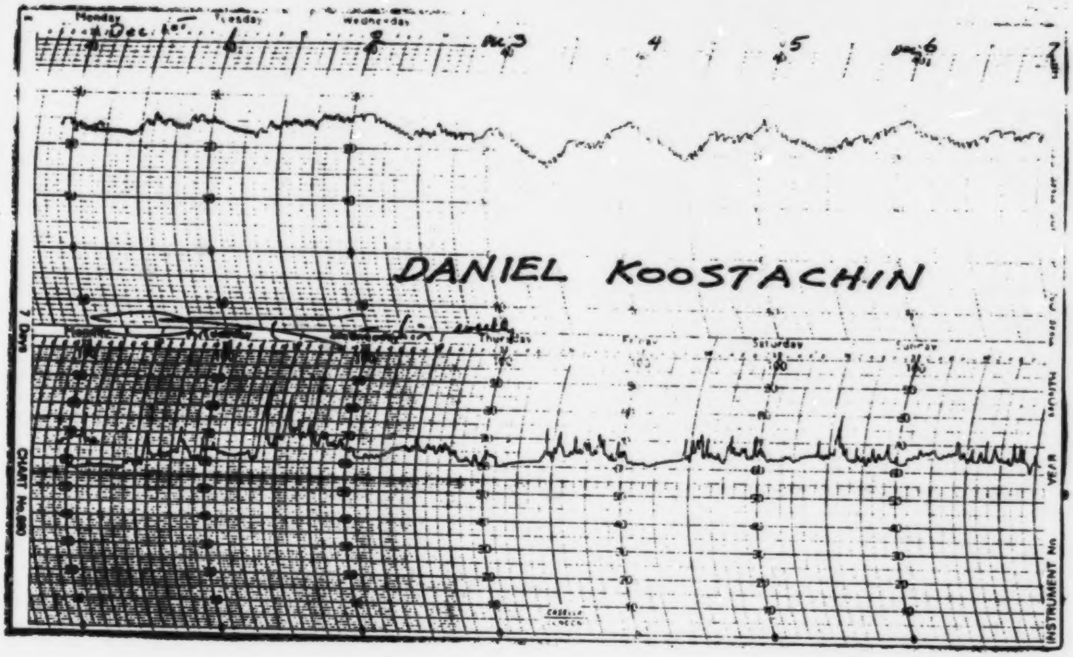
DANIEL KOOSTACHIN

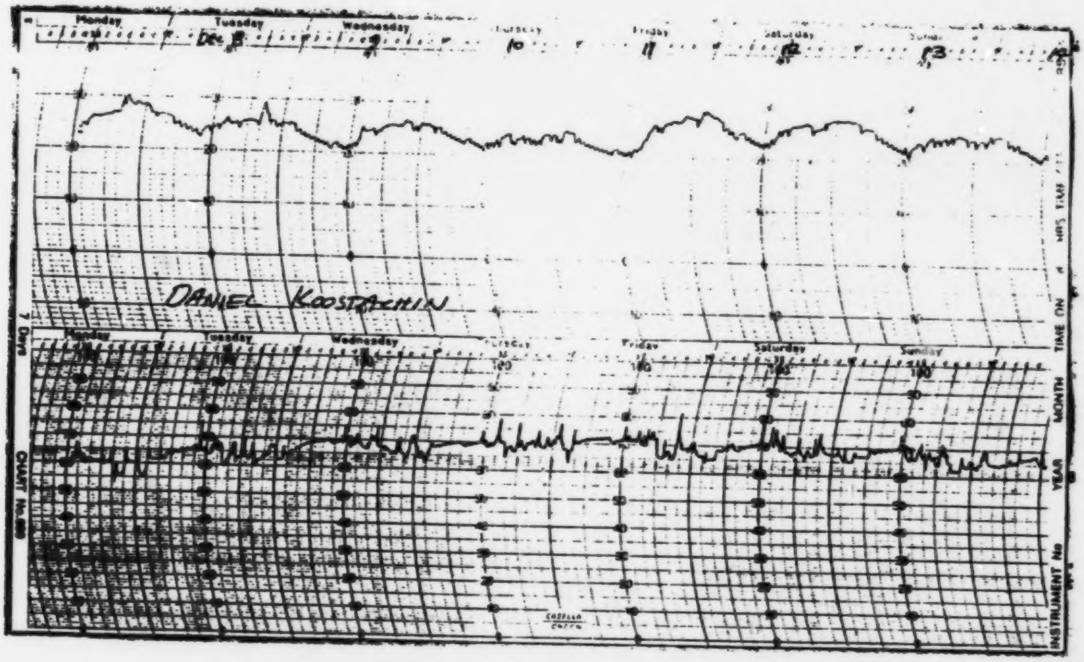
MONTHLY GRAPH

SHOWS
HEAT EXCHANGER
CYCLING

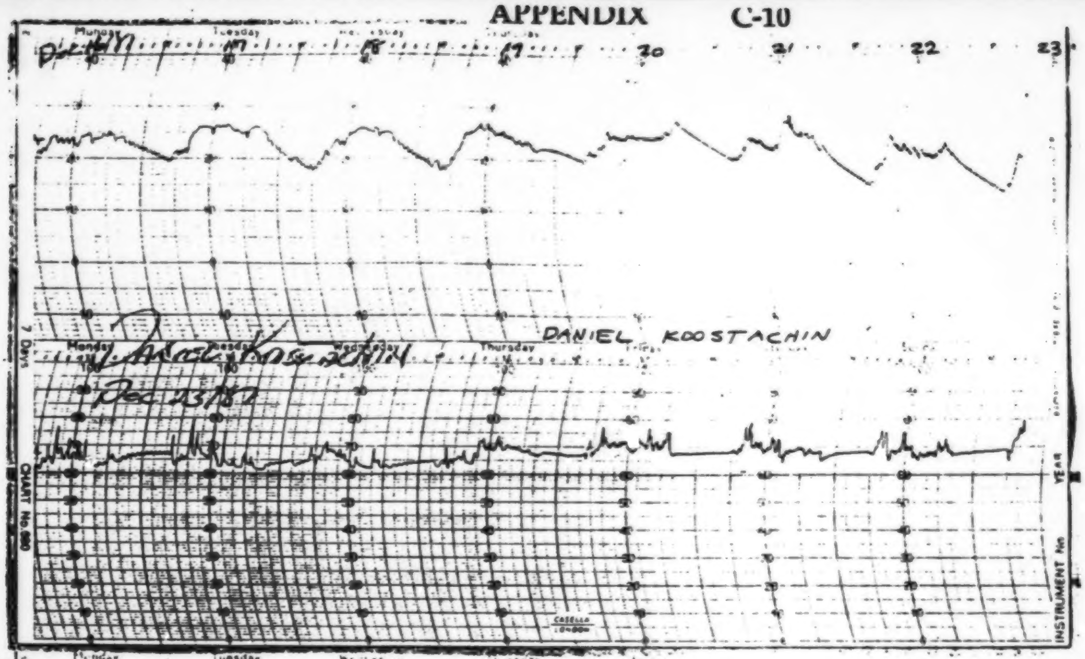
WEEKLY GRAPH

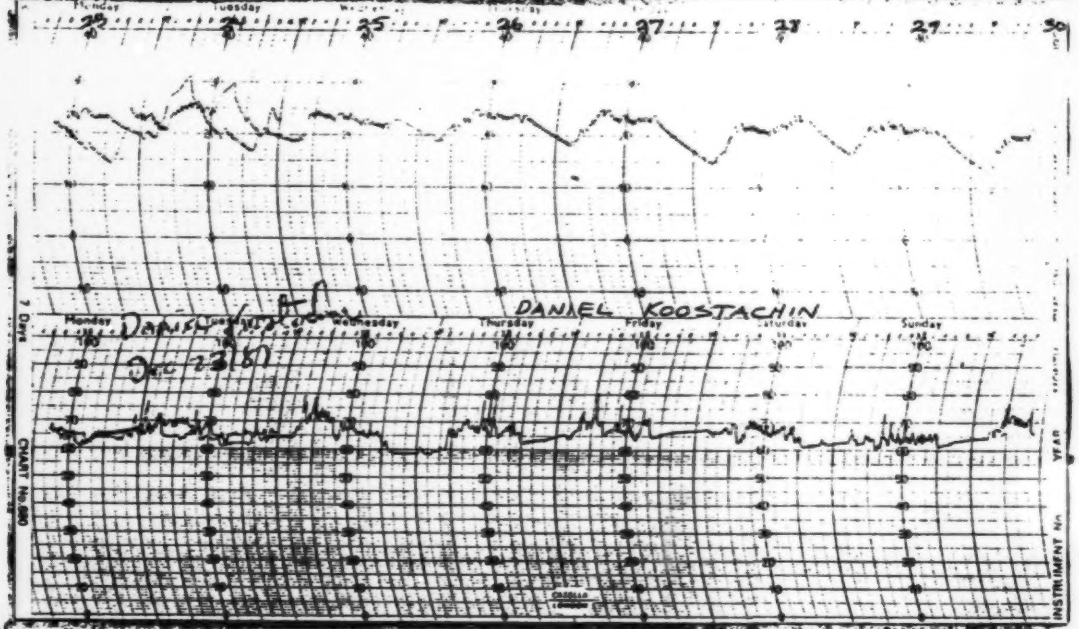


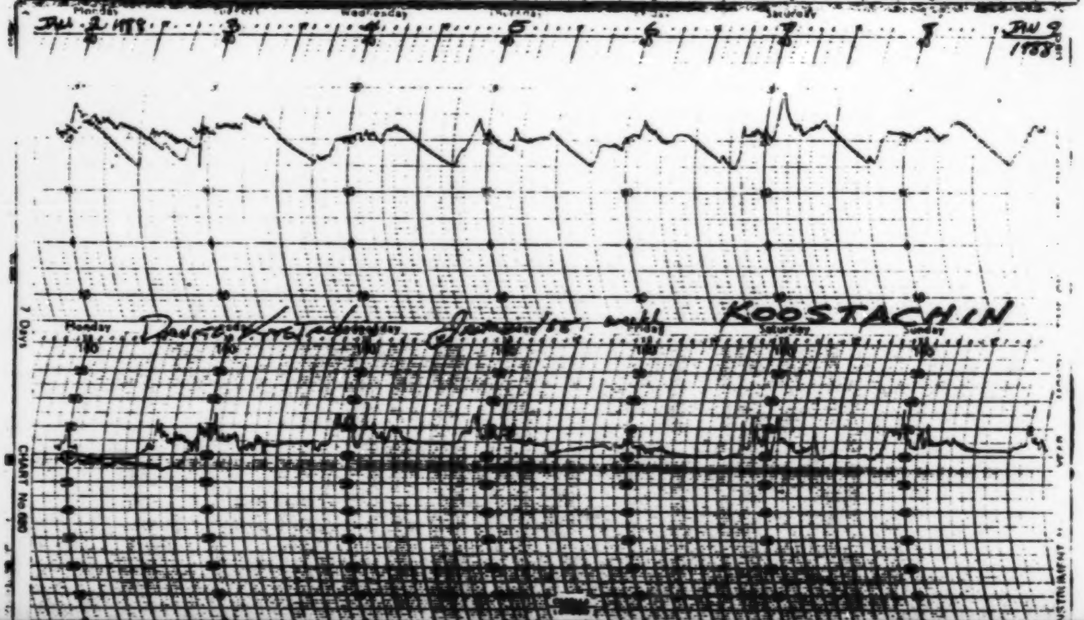

Monday
Tuesday
Wednesday
Dec 1st
2
3
4
5
6
7
DANIEL KOOSTACHIN
Thursday
Friday
Saturday
Sunday
7 Days
CHART No.
INSTRUMENT No
YEAR
MONTH
CASELLA
LONDON


Monday
Tuesday
Wednesday
Thursday
Friday
Saturday
Sunday
Dec 8
9
10
11
12
13
14
DANIEL KOOSTACHIN
7 Days
CHART No.
INSTRUMENT No
YEAR
MONTH
TIME ON
HRS TIME
CASELLA
LONDON

APPENDIX C-10



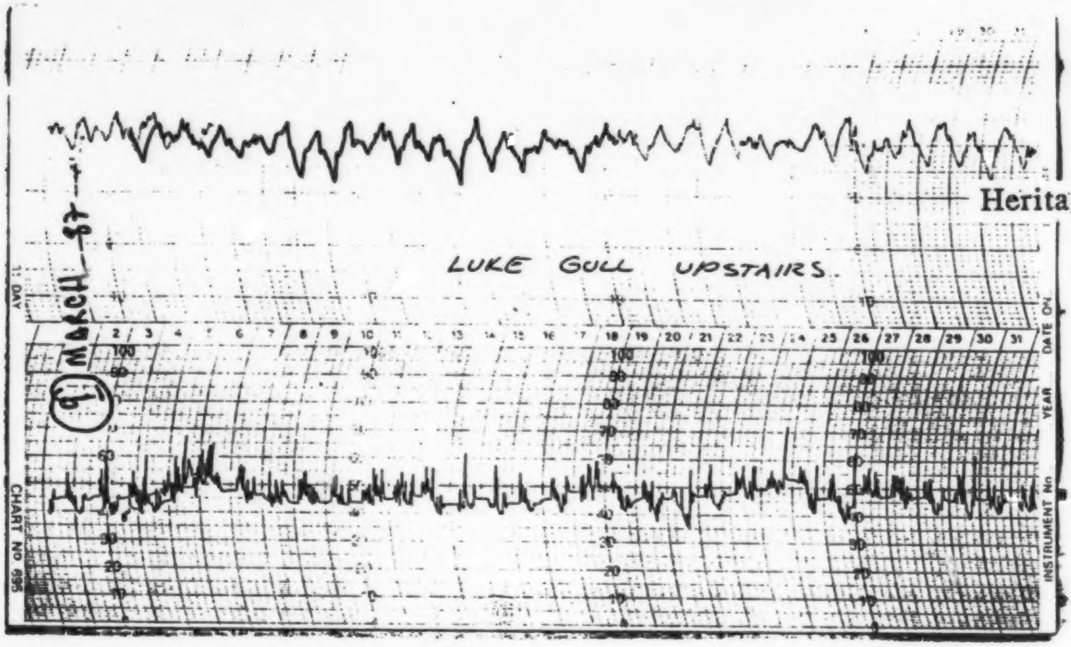


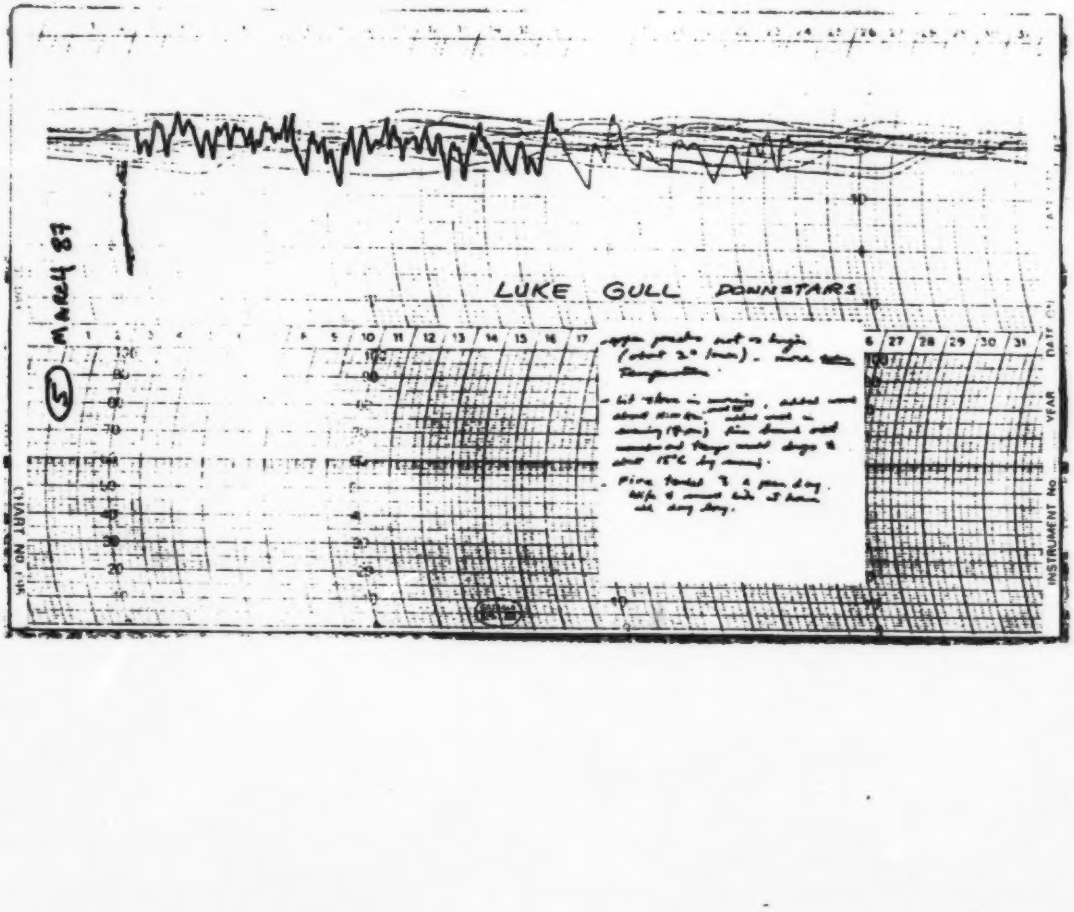


APPENDIX C-11

House 80
Luke Gull

Heritage Cartier-1





APPENDIX D-1

MONTHLY CLIMATOLOGICAL SUMMARY

STATION MOOSONEE (CLIM) PROVINCE ONTARIO MONTH OCTOBER YEAR 1987

DATE 1	TEMPERATURE 2	3	4	5	°C 6	PRECIPITATION 7	8	9	10	SEA LEVEL PRESSURE First Synoptic Hour 01 EST 11	Second Synoptic Hour 07 EST 12	Third Synoptic Hour 13 EST 13	Fourth Synoptic Hour 19 EST 14	VAPOUR PRESSURE First Synoptic Hour 01 EST 15	Second Synoptic Hour 07 EST 16	Third Synoptic Hour 13 EST 17	Fourth Synoptic Hour 19 EST 18	STATION PRESSURE First Synoptic Hour 01 EST 19	Second Synoptic Hour 07 EST 20	Third Synoptic Hour 13 EST 21	Fourth Synoptic Hour 19 EST 22	DATE 23	DAYS WITH 24	25	26	27	28	29	30	31	32	PEAK WIND SPEED 33	34	35	NOTES	SUNSHINE
1	5.9	-0.5	5.4	2.7	15.3	6.2	0	0	6.2	1011.8	1009.0	1003.8	1007.1	5.7	6.3	5.1	6.8	1010.5	1007.7	1002.5	1000.4	1										11	20	05		0.0
2	5.1	-1.5	3.6	1.8	16.2	0.8	0.2	0.2	1.0	1003.8	1009.1	1012.1	1017.1	7.1	6.3	4.9	4.4	1002.5	1007.8	1010.8	1015.8	2										04	30	17		0.0
3	7.0	-2.7	4.3	2.2	15.8	0	0.2	0.2	0.2	1019.9	1022.8	1021.9	1019.3	5.5	5.1	3.8	4.3	1018.6	1021.5	1020.6	1018.0	3														4.3
4	[illegible]	0.7	[illegible]	7.3	[illegible]	0.4	0	0	0.4	1015.5	1009.3	[illegible]	1001.5	5.1	6.1	7.1	8.7	1014.2	1008.0	1004.0	1000.2	4										M	20	12		5.1
5	16.0	4.6	20.6	10.3	7.7	0.5	0	0	0.5	998.9	[illegible]	[illegible]	[illegible]	9.0	7.8	10.0	11.5	997.6	996.3	996.0	995.1	5														2.7
6	13.4	2.2	15.6	7.8	10.2	6.4	0	0	6.4	994.3	994.4	995.2	1002.4	11.5	9.7	11.1	8.4	993.0	993.1	993.9	1000.1	6										32	24	01		0.0
7	[illegible]	0.3	4.9	[illegible]	[illegible]	2.0	TR	TR	2.0	[illegible]	1008.1	1009.8	1009.3	7.1	6.8	6.8	6.1	1005.7	1007.9	1008.5	1008.0	7										34	25	21		0.0
8	[illegible]	-3.4	1.3	[illegible]	17.3	0	TR	TR	TR	1010.2	1012.7	1014.6	1014.0	5.7	4.7	4.5	[illegible]	[illegible]	1011.4	1013.3	1014.7	8										16	22	M		4.0
9	[illegible]	-4.0	[illegible]	[illegible]	[illegible]	0	TR	TR	TR	1016.1	1014.4	1011.2	1013.4	4.1	4.2	4.7	4.1	1014.8	1013.1	1009.9	1012.1	9														0.0
10	4.2	-1.6	2.6	1.3	16.7	0	TR	TR	TR	[illegible]	[illegible]	1023.0 1022.9	1011.8	4.9	4.1	3.5	4.1	1016.7	1010.6	1011.7	1021.5	10										26	27	21		1.7
11	5.4	-1.7	3.7	1.9	16.1	TR	TR	TR	TR	[illegible]	[illegible]	1019.0	1018.7	4.1	4.7	4.5	3.7	1020.1	1019.1	1017.7	1017.4	11														0.1
12	4.6	-5.9	-1.3	-0.7	18.7	0	0	0	0	1018.5	1019.1	1019.2	1019.4	5.3	[illegible]	3.9	3.8	1017.2	1017.8	1017.9	1018.1	12														4.7
13	10.2	-4.4	5.8	2.9	15.1	0.6	0	0	0.6	1018.8	1018.4	1015.7	1008.7	4.5	4.1	5.1	5.9	1017.5	1017.1	1012.4	1007.4	13										20	20	23		5.6
14	12.2	4.5	16.7	8.4	9.6	0	0	0	0	1002.9	1001.9	1004.0	1011.9	7.1	7.3	6.8	6.1	1001.6	1000.4	1003.3	1006	14										26	31	21		3.7
15	5.2	-1.1	4.1	2.1	15.9	0	0	0	0	1019.1	1024.3	1027.0	1028.5	6.8	5.5	4.5	4.5	1017.8	1023.0	1025.7	1027.2	15														2.2
16	5.8	-1.2	4.6	2.3	15.7	10.5	0	0	10.5	1028.4	1026.6	1022.7	1017.7	4.7	5.3	5.9	7.6	1027.1	1025.3	1021.4	1016.4	16										16	20	05		0.0
17	5.1	3.6	8.7	4.4	13.6	6.5	0	0	6.5	1012.4	1010.2	1009.7	1008.3	7.8	7.8	8.4	8.1	1011.1	1008.9	1007.9	1007.0	17														0.0
18	5.8	3.4	9.2	4.1	13.9	1.6	0	0	1.6	1006.4	1007.4	1007.0	1005.6	8.4	7.3	7.1	8.4	1005.1	1006.1	1005.7	1004.3	18										21	18	05		0.1
19	7.0	-0.1	6.9	3.5	14.5	0.6	0	0	0.6	1005.0	1007.6	1009.6	1012.5	7.3	6.6	6.4	6.1	1003.7	1006.3	1008.3	1011.2	19										24	20	19		1.9
20	5.6	-2.5	3.1	1.6	16.4	0	TR	TR	TR	1013.7	1015.2	1015.1	1015.7	5.3	4.7	4.4	5.7	1012.4	1013.9	1013.8	1014.4	20										28	18	19		4.9
21	7.2	-3.7	3.5	-0.8	18.8	0	3.6	3.4	3.4	1014.6	1014.9	1017.3	1019.7	5.5	5.9	5.9	5.3	1013.3	1013.6	1016.0	1018.4	21										32	M	17		4.5
22	0.2	-5.9	-5.7	2.9	20.9	0	TR	TR	TR	1020.7	1021.8	1022.7	1023.2	4.4	4.4	5.7	4.2	1019.4	1020.9	1021.4	1021.9	22														0.6
23	0.7	-3.8	[illegible]	-1.5	19.5	0	TR	TR	TR	1023.7	1025.3	1026.0	1027.8	4.5	4.1	5.5	3.1	1022.4	1024.0	1025.5	1027.5	23														0.0
24	7.2	-9.7	[illegible]	[illegible]	21.8	0	0	0	0	1029.4	1030.1	1029.6	1029.4	3.8	2.8	2.9	3.6	1028.1	1028.8	1028.3	1028.0	24														7.3
25	4.7	-11.2	-6.5	-3.3	21.3	0	0	0	0	1028.0	1026.4	1024.1	1014.7	2.6	2.3	3.7	4.1	1026.7	1025.0	1019.8	1013.4	25														6.5
26	8.8	0.0	8.8	4.4	13.6	0.4	0	0	0.4	1011.1	1007.8	1005.1	1002.9	4.9	6.3	7.4	7.3	1009.8	1006.5	1003.8	1001.6	26										21	20	18		0.0
27	8.2	-0.2	8.0	4.0	14.0	7.3	TR	TR	7.3	1001.8	1000.8	1001.4	1004.5	6.1	7.6	8.4	7.1	1000.5	999.5	1000.1	1003.2	27										M	18	07		0.0
28	2.0	-4.8	-2.8	-1.4	19.4	0	TR	TR	TR	1009.4	1014.9	1015.8	1017.5	5.7	4.7	4.7	4.2	1008.1	1013.6	1014.5	1016.2	28														3.2
29	2.0	-4.0	-2.0	-1.0	19.0	0	2.0	1.4	1.4	1017.2	1017.3	1016.6	1014.5	4.5	4.2	4.7	4.4	1015.9	1016.0	1015.3	1013.2	29														1.8
30	3.0	-1.6	1.4	0.7	17.3	0	TR	TR	TR	1010.7	1007.7	1012.9	1019.9	4.4	5.1	5.9	5.3	1009.4	1006.4	1011.6	1018.6	30														0.0
31	[illegible]	-5.8	-6.9	-3.4	21.4	0	4.4	1.6	1.6	1026.3	1029.7	1032.8	1033.5	4.9	3.6	6.1	4.9	1025.0	1029.7	1031.4	1034.1	31														0.0
—																						—														
—																						—														

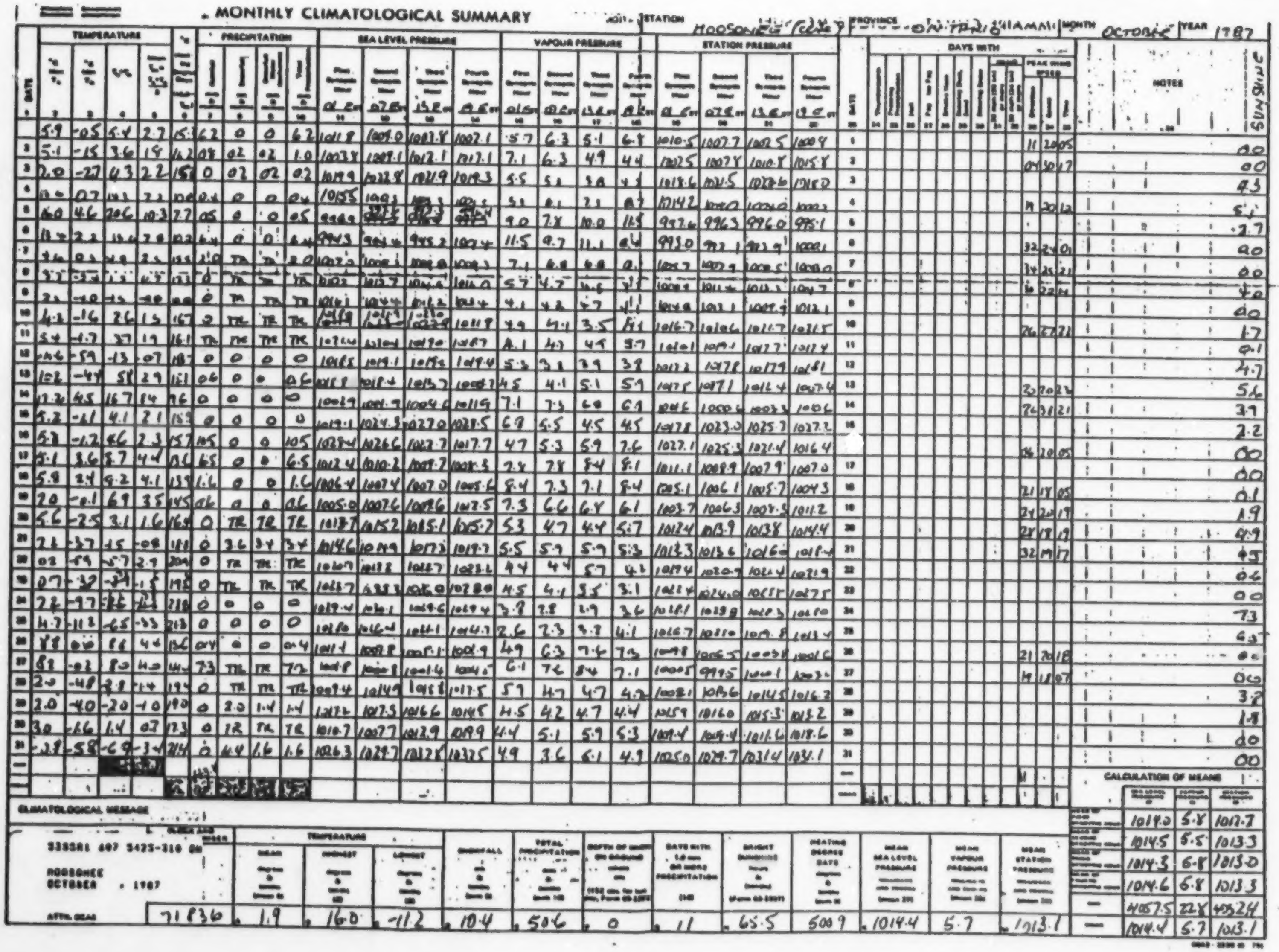
CLIMATOLOGICAL MESSAGE

	BLOCK AND INDEX	TEMPERATURE MEAN	HIGHEST	LOWEST	SNOWFALL	TOTAL PRECIPITATION	DEPTH OF SNOW ON GROUND	DAYS WITH 1.0 mm OR MORE PRECIPITATION	BRIGHT SUNSHINE	HEATING DEGREE DAYS	MEAN SEA LEVEL PRESSURE	MEAN VAPOUR PRESSURE	MEAN STATION PRESSURE
3335R1 607 5423-310 GN MOOSONEE OCTOBER · 1987	71836	1.9	16.0	-11.2	10.4	50.6	0	11	65.5	500.9	1014.4	5.7	1013.1

CALCULATION OF MEANS

	SEA LEVEL PRESSURE	VAPOUR PRESSURE	STATION PRESSURE
First synoptic hour	1014.0	5.8	1012.7
Second synoptic hour	1014.5	5.5	1013.3
Third synoptic hour	1014.3	6.8	1013.0
Fourth synoptic hour	1014.6	6.8	1013.3
—	4057.5	22.8	4052.4
—	1014.4	5.7	1013.1

APPENDIX D-2



MONTHLY CLIMATOLOGICAL SUMMARY

STATION MOOSONEE — PROVINCE ONTARIO — MONTH OCTOBER — YEAR 1987

DATE	TEMPERATURE				°C	PRECIPITATION				SEA LEVEL PRESSURE 01 Em	07 Em	13 Em	19 Em	VAPOUR PRESSURE 01 Em	07 Em	13 Em	19 Em	STATION PRESSURE 01 Em	07 Em	13 Em	19 Em	DATE	PEAK WIND SPEED			NOTES	SUNSHINE
1	5.9	-0.5	5.4	2.7	15.3	6.2	0	0	6.2	1011.8	1009.0	1007.8	1007.1	5.7	6.3	5.1	6.4	1010.5	1007.7	1002.5	1000.4	1	11	20	05		0.0
2	5.1	-1.5	3.6	1.9	16.2	0.8	0.2	0.2	1.0	1003.8	1009.1	1012.1	1017.1	7.1	6.3	4.9	4.4	1002.5	1007.8	1010.8	1015.8	2	04	30	17		0.0
3	7.0	-2.7	4.3	2.2	15.8	0	0.2	0.2	0.2	1019.9	1022.8	1021.9	1019.3	5.5	5.1	3.8	4.1	1018.6	1021.5	1020.6	1018.0	3					4.3
4	13.0	0.7	[illegible]	[illegible]	[illegible]	2.4	0	0	2.4	1015.5	[illegible]	[illegible]	[illegible]	5.1	8.1	7.1	8.7	1014.2	1009.0	1006.0	[illegible]	4	19	20	12		5.1
5	16.0	4.6	20.6	10.3	7.7	0.5	0	0	0.5	998.9	[illegible]	[illegible]	[illegible]	9.0	7.8	10.0	11.5	997.6	996.3	996.0	995.1	5					2.7
6	[illegible]	2.2	[illegible]	[illegible]	10.2	6.4	0	0	6.4	994.3	[illegible]	995.2	1002.4	11.5	9.7	11.1	8.4	993.0	993.1	993.9	1002.1	6	32	24	01		0.0
7	[illegible]	0.3	[illegible]	2.3	[illegible]	2.0	TR	TR	2.0	[illegible]	[illegible]	[illegible]	1009.3	7.1	[illegible]	[illegible]	[illegible]	1005.7	1007.9	1008.5	1008.0	7	34	25	21		0.0
8	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	0	TR	TR	TR	[illegible]	1012.7	[illegible]	1016.0	5.7	4.7	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	1014.7	8	16	22	14		4.0
9	[illegible]	-4.0	[illegible]	[illegible]	[illegible]	0	TR	TR	TR	1016.1	1014.4	1011.2	1013.4	4.1	4.2	4.7	4.1	1014.8	1013.1	1009.9	1012.1	9					0.0
10	4.2	-1.6	2.6	1.5	16.7	0	TR	TR	TR	[illegible]	[illegible]	[illegible]	1011.8	4.9	4.1	3.5	4.1	1016.7	1010.6	1011.7	1031.5	10	26	27	22		1.7
11	5.4	-1.7	3.7	1.9	16.1	TR	TR	TR	TR	[illegible]	[illegible]	1019.0	1018.7	4.1	4.7	4.5	5.7	1020.1	1019.1	1017.7	1017.4	11					0.1
12	[illegible]	-5.9	-1.3	-0.7	18.7	0	0	0	0	1018.5	1019.1	1019.2	1019.4	5.3	[illegible]	3.9	3.8	1017.2	1017.8	1017.9	1018.1	12					4.7
13	10.2	-4.4	5.8	2.9	15.1	0.6	0	0	0.6	[illegible]	1018.4	1013.7	1008.7	4.5	4.1	5.1	5.9	1017.5	1017.1	1012.4	1007.4	13	22	20	22		5.6
14	17.2	4.5	16.7	8.4	7.6	0	0	0	0	1002.9	1001.9	1004.6	1011.9	7.1	7.3	6.8	6.9	1001.6	1000.6	1003.3	1010.6	14	26	31	21		3.7
15	5.2	-1.1	4.1	2.1	15.9	0	0	0	0	1019.1	1024.3	1027.0	1028.5	6.8	5.5	4.5	4.5	1017.8	1023.0	1025.7	1027.2	15					2.2
16	5.8	-1.2	4.6	2.3	15.7	10.5	0	0	10.5	1028.4	1026.6	1022.7	1017.7	4.7	5.3	5.9	7.6	1027.1	1025.3	1021.4	1016.4	16	26	20	05		0.0
17	5.1	3.6	8.7	4.4	13.6	6.5	0	0	6.5	1012.4	1010.2	1009.7	1008.3	7.8	7.8	8.4	8.1	1011.1	1008.9	1007.9	1007.0	17					0.0
18	5.8	3.4	9.2	4.1	13.9	1.6	0	0	1.6	1006.4	1007.4	1007.0	1005.6	8.4	7.3	7.1	8.4	1005.1	1006.1	1005.7	1004.3	18	21	18	05		0.1
19	7.0	-0.1	6.9	3.5	14.5	0.6	0	0	0.6	1005.0	1007.6	1009.6	1012.5	7.3	6.6	6.4	6.1	1003.7	1006.3	1008.3	1011.2	19	24	24	19		1.9
20	5.6	-2.5	3.1	1.6	16.4	0	TR	TR	TR	1013.7	1015.2	1015.1	1015.7	5.3	4.7	4.4	5.7	1012.4	1013.9	1013.8	1014.4	20	28	18	19		4.9
21	7.2	-3.7	1.5	-0.8	18.1	0	3.6	3.4	3.4	1014.6	1014.9	1017.3	1019.7	5.5	5.9	5.9	5.3	1013.3	1013.6	1016.0	1018.4	21	32	19	17		4.5
22	0.2	-5.9	-5.7	-2.9	20.4	0	TR	TR	TR	1020.7	1021.8	1022.7	1023.2	4.4	4.4	5.7	4.2	1019.4	1020.5	1021.4	1021.9	22					0.6
23	0.7	-3.2	[illegible]	-1.5	19.5	0	TR	TR	TR	1028.7	[illegible]	1026.0	1028.0	4.5	4.1	5.5	3.1	1022.4	1024.0	1025.5	1027.5	23					0.0
24	7.2	-9.7	[illegible]	[illegible]	21.8	0	0	0	0	1029.4	[illegible]	1029.6	1029.4	3.8	2.8	2.9	3.6	1028.1	1029.8	1028.3	1028.0	24					7.3
25	4.7	-11.2	-6.5	-3.3	21.3	0	0	0	0	1028.0	[illegible]	1014.1	1014.7	2.6	7.3	3.8	4.1	1026.7	1025.0	1019.8	1013.4	25					6.5
26	8.8	[illegible]	8.8	4.4	13.6	0.4	0	0	0.4	1011.1	1007.8	1005.1	1002.9	4.9	6.3	7.4	7.3	1009.8	1006.5	1003.8	1001.6	26	21	20	18		0.0
27	8.2	-0.2	8.0	4.0	14.0	7.3	TR	TR	7.3	1001.8	1000.8	1001.4	1004.5	6.1	7.6	8.4	7.1	1000.5	999.5	1000.1	1003.2	27	19	18	07		0.0
28	2.0	-4.8	-2.8	-1.4	19.4	0	TR	TR	TR	1009.4	1014.9	1015.8	1017.5	5.9	4.7	4.7	4.2	1008.1	1013.6	1014.5	1016.2	28					3.8
29	2.0	-4.0	-2.0	-1.0	19.0	0	2.0	1.4	1.4	1017.2	1017.3	1016.6	1014.5	4.5	4.2	4.7	4.4	1015.9	1016.0	1015.3	1013.2	29					1.8
30	3.0	-6.6	1.4	0.7	17.3	0	TR	TR	TR	1010.7	1007.7	1012.9	1019.9	4.4	5.1	5.9	5.3	1009.4	1009.4	1011.6	1018.6	30					0.0
31	-3.9	-5.8	-6.9	-3.4	21.4	0	4.4	1.6	1.6	1026.3	1029.7	1032.8	1032.5	4.9	3.6	6.1	4.9	1025.0	1029.7	1031.4	1034.1	31					0.0

CLIMATOLOGICAL MESSAGE

333SR1 407 3425-310 ON

MOOSONEE
OCTOBER , 1987

	TEMPERATURE MEAN	HIGHEST	LOWEST	SNOWFALL	TOTAL PRECIPITATION	DEPTH OF SNOW ON GROUND	DAYS WITH 1.0 mm OR MORE PRECIPITATION	BRIGHT SUNSHINE	HEATING DEGREE DAYS	MEAN SEA LEVEL PRESSURE	MEAN VAPOUR PRESSURE	MEAN STATION PRESSURE
71836	1.9	16.0	-11.2	10.4	50.6	0	11	65.5	500.9	1014.4	5.7	1013.1

CALCULATION OF MEANS

	SEA LEVEL PRESSURE	VAPOUR PRESSURE	STATION PRESSURE
	1014.0	5.8	1012.7
	1014.5	5.5	1013.3
	1014.3	6.8	1013.0
	1014.6	6.8	1013.3
—	4057.5	22.8	4052.4
—	1014.4	5.7	1013.1

MONTHLY CLIMATOLOGICAL SUMMARY

STATION MOOSONEE (UAC) | PROVINCE ONTARIO | MOOSONEE | MONTH NOVEMBER | YEAR 1987

DATE	TEMPERATURE					PRECIPITATION				SEA LEVEL PRESSURE			
1	2	3	4	5	6	7	8	9	10	01E	07E	13E	19E
1	-0.9	-4.3	-5.2	-2.6	216	0	TR	TR	TR	1033.4	1036.0	1037.5	1036.6
2	6.4	-1.7	4.7	2.4	156	1.7	0	0	1.7	1032.0	1024.7	1017.2	1010.3
3	5.0	1.0	7.0	3.0	152	0.6	0	0	0.6	1010.2	[illegible]	1009.7	[illegible]
4	3.7	-2.0	2.9	1.3	[illegible]	2.2	1.0	[illegible]	[illegible]	994.1	992.1	992.0	[illegible]
5	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	0	1.0	0.9	0.9	[illegible]	1007.0	1009.1	1012.3
6	-7.1	[illegible]	-12.5	[illegible]	[illegible]	0	1.0	0.2	0.2	1012.0	1012.0	[illegible]	[illegible]
7	-2.7	-10.7	-11.4	-6.7	247	0	0	0	0	1007.7	1002.2	1008.6	1008.7
8	-1.5	-8.9	-10.4	-5.2	232	0	0	TR	TR	1009.1	1011.6	1013.2	1017.4
9	-5.0	-8.9	-13.9	-7.0	250	0	2.0	1.0	1.0	1018.1	1019.9	1018.5	[illegible]
10	-3.1	-9.2	-13.3	-6.2	242	0	0.4	0.2	0.2	1027.8	1030.7	1031.6	[illegible]
11	3.2	-8.7	-5.5	2.8	208	TR	TR	TR	TR	1013.6	[illegible]	1008.2	[illegible]
12	1.1	-0.7	0.4	0.2	[illegible]	[illegible]	TR	TR	TR	1008.5	1009.2	1006.9	[illegible]
13	2.9	-1.8	1.1	0.6	[illegible]	0.2	1.0	0.6	0.8	1000.1	997.1	999.4	1003.7
14	0.4	-12.9	-12.5	-6.3	243	0	1.0	0.6	0.6	[illegible]	1015.4	1021.5	1027.3
15	0.3	-14.6	-14.3	-7.2	252	0	0	0	0	1030.7	1033.5	1032.1	1027.2
16	7.0	-1.8	6.2	2.6	154	4.3	0	0	4.3	1024.8	1020.0	1016.2	1011.1
17	7.4	[illegible]	6.0	3.0	150	24.0	3.4	2.6	23.6	1008.0	[illegible]	[illegible]	995.5
18	-1.0	[illegible]	[illegible]	[illegible]	[illegible]	0	6.0	3.4	3.4	997.1	[illegible]	1011.0	[illegible]
19	0.1	-19.2	-18.9	[illegible]	[illegible]	0	11.0	6.4	6.4	[illegible]	996.2	1000.4	1009.1
20	[illegible]	-20.3	[illegible]	-17.0	[illegible]	0	1.2	0.0	0.0	1010.9	[illegible]	[illegible]	1017.1
21	-10.7	-20.1	-30.8	-15.4	[illegible]	0	TR	TR	TR	[illegible]	[illegible]	[illegible]	[illegible]
22	-3.0	-16.7	-21.7	[illegible]	[illegible]	0	0	0	0	[illegible]	1018.1	[illegible]	1011.5
23	[illegible]	-9.4	[illegible]	-4.7	[illegible]	0	2.6	1.8	1.7	1009.6	1007.8	1002.6	1012.1
24	-8.6	-14.1	-22.7	-11.4	[illegible]	0	0.4	0.2	0.2	[illegible]	1016.5	[illegible]	[illegible]
25	-8.3	-18.2	-26.5	-13.3	[illegible]	0	TR	TR	TR	1039.0	1040.9	[illegible]	[illegible]
26	-4.2	-20.5	-24.7	[illegible]	[illegible]	0	0	0	0	[illegible]	1037.3	1035.0	1031.8
27	-0.4	-7.3	-7.7	-3.9	219	0	0	0	0	1029.0	1028.7	1027.6	1030.2
28	-1.0	-9.0	-10.0	[illegible]	[illegible]	0	TR	TR	0	1029.5	1027.5	1024.2	1021.3
29	[illegible]	-9.0	-11.6	-5.8	[illegible]	TR	TR	TR	TR	1019.3	[illegible]	[illegible]	[illegible]
30	-1.6	-4.5	-6.1	-3.1	211	TR	2.8	1.6	1.6	1004.9	1006.2	[illegible]	1003.7
31										1004.5			
—	36.9	[illegible]	[illegible]	[illegible]		24.0	35.6			[illegible]	30492.6	[illegible]	30491.4
—	-1.2	-9.6	-13.8	-5.4	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	1016.5	1016.4	1015.8	1016.4

DATE	VAPOUR PRESSURE				STATION PRESSURE				DAYS WITH									PEAK WIND SPEED			NOTES
	01E	07E	13E	19E	01E	07E	13E	19E													Snowfall
1	4.2	4.5	5.3	4.2	1032.0	1034.6	1036.1	1035.2													0.0
2	5.1	4.9	6.6	7.1	1031.6	1023.4	1015.9	1009.0										23	20	23	2.7
3	5.1	6.0	6.6	7.1	1008.9	1011.3	[illegible]	1005.0				1									0.0
4	[illegible]	6.1	6.4	6.1	[illegible]	991.0	990.7	[illegible]										30	25	[illegible]	0.0
5	4.7	3.0	3.2	2.9	[illegible]	1005.7	[illegible]	1010.9										30	26	07	0.0
6	3.4	2.1	2.2	2.2	1010.6	[illegible]	[illegible]	[illegible]										30	18	16	[illegible]
7	2.0	2.5	7.3	2.0	1006.3	[illegible]	1005.2	1006.9										27	25	19	6.9
8	2.4	2.3	2.9	2.4	1007.7	1010.0	[illegible]	1016.0										27	17	14	1.8
9	7.5	1.4	3.3	3.2	1016.8	1018.5	1021.1	[illegible]										27	17	15	0.8
10	3.3	2.8	3.2	2.4	1026.4	[illegible]	[illegible]	[illegible]													1.5
11	2.6	3.5	4.9	5.4	[illegible]	1011.8	[illegible]	1007.2										21	24	17	1.4
12	6.1	5.5	5.5	6.1	1007.2	1007.9	1005.6	1003.3													0.0
13	5.9	6.3	5.7	5.5	[illegible]	[illegible]	[illegible]	1002.5										28	18	17	0.6
14	5.1	3.8	3.6	2.9	1007.5	1014.1	1020.2	1025.9													[illegible]
15	1.9	2.5	5.7	4.1	1029.3	1032.1	1032.7	1027.9													0.7
16	4.4	6.1	5.9	8.1	1023.5	1018.6	1014.9	1009.8													0.0
17	9.0	9.7	7.3	6.1	1006.7	[illegible]	[illegible]	[illegible]				1						26	25	[illegible]	0.0
18	5.7	2.0	2.2	2.2	996.0	[illegible]	[illegible]	1011.1										32	26	[illegible]	3.7
19	3.3	3.9	3.3	1.4	1002.4	994.6	999.0	1007.7										31	27	16	1.2
20	1.1	1.2	1.5	1.1	[illegible]	[illegible]	1013.0	1015.7										[illegible]	[illegible]	[illegible]	[illegible]
21	1.3	1.2	1.9	1.4	[illegible]	1017.9	[illegible]	[illegible]										[illegible]	[illegible]	[illegible]	6.6
22	1.1	1.6	2.7	3.8	1009.7	1016.7	1012.4	1010.1													0.0
23	4.4	4.9	5.7	4.1	1007.9	[illegible]	[illegible]	1010.8										34	24	02	0.0
24	7.6	1.8	2.0	2.2	1016.9	[illegible]	[illegible]	1036.1													1.2
25	[illegible]	[illegible]	2.1	2.2	1037.6	[illegible]	[illegible]	[illegible]													4.6
26	1.8	1.1	2.4	2.6	1037.0	[illegible]	1033.6	1030.4													2.8
27	3.2	3.3	5.3	5.3	1027.6	1027.3	1027.3	1028.9													0.0
28	5.1	5.1	3.8	4.1	1022.2	[illegible]	1022.9	1020.0													3.2
29	2.8	4.2	4.7	4.1	1017.9	[illegible]	1010.6	1007.6		1		1						35	22	[illegible]	0.0
30	4.5	5.1	4.7	4.4	[illegible]	1004.9	1002.7	1002.4		1								35	22	18	0.0
31	4.2				[illegible]			[illegible]													49.1
—	117.2	115.5	131.1	119.1	[illegible]	30452.7	30454.5	[illegible]		2		3									
—	3.7	3.9	4.4	4.0	1015.1	1015.1	[illegible]	1015.0													

CALCULATION OF MEANS

	1016.5	3.9	1015.1
	1016.4	3.9	1015.1
	1015.8	4.4	1014.5
	1016.4	4.0	1015.0
—	4065.1	16.1	4057.7
—	1016.3	4.0	1014.9

CLIMATOLOGICAL MESSAGE

8355R1 607 5423-310 ON

MOOSONEE
NOVEMBER , 1987

	TEMPERATURE MEAN	TEMPERATURE HIGHEST	TEMPERATURE LOWEST	SNOWFALL	TOTAL PRECIPITATION	DEPTH OF SNOW ON GROUND	DAYS WITH 1.0 mm OR MORE PRECIPITATION	BRIGHT SUNSHINE	HEATING DEGREE DAYS	MEAN SEA LEVEL PRESSURE	MEAN VAPOUR PRESSURE	MEAN STATION PRESSURE
71836	-5.4	7.4	-20.5	35.6	60.2	20	9	49.1	703.4	1016.3	4.0	1014.9

OAESH

4007 WTL 6010738-230 OXT
BIG TROUT LAKE

MONTHLY CLIMATOLOGICAL SUMMARY

STATION: BIG TROUT LAKE
PROVINCE: ONTARIO
MONTH: OCTOBER
YEAR: 1987

DATE 1	TEMPERATURE 2	3	4	5	°C 6	PRECIPITATION 7	8	9	10	SEA LEVEL PRESSURE 00 GMT 11	06 GMT 12	18 GMT 13	18 GMT 14
1	1.3	-1.6	0.2	0.1	17.8	0	14.2	14.2	14.2	1003.0	995.9	1008.1	1016.6
2	1.1	-2.4	-1.5	-0.8	19.5	0	0.2	0.1	0.2	1022.9	1026.3	1027.3	1025.4
3	11.8	1.0	14.8	7.4	10.6	TR	0	0	TR	1005	[illegible]	[illegible]	[illegible]
4	16.5	5.0	21.5	10.8	7.2	1.4	0	0	1.4	1002.8	1002.3	1001.0	999.7
5	5.2	0.7	5.9	8.0	15.0	28	TR	TR	28.6	1000.5	1001.8	1004.9	1008.5
6	1.0	-1.6	-0.6	-0.8	18.8	0.4	TR	TR	0.4	1010.0	1012.1	1015.7	1020.1
7	0.0	-2.4	-2.9	-1.5	19.5	0	0.6	0.6	0.6	1031.2	1033.0	1032.7	1033.1
8	0.5	-4.2	-2.7	-1.4	19.4	0	TR	TR	TR	1021.7	1021.9	1020.0	1018.7
9	-1.0	-2.9	-3.9	-2.0	20.0	0	TR	TR	TR	1018.2	1018.2	1019.8	1022.4
10	0.0	-2.1	-2.1	-1.1	19.1	0	TR	TR	TR	1022.5	1022.0	1022.5	1021.6
11	3.7	-2.7	1.0	0.5	17.5	0	0	0	0	1020.2	1019.7	1019.1	1019.3
12	7.4	0.9	8.3	4.2	12.8	0	0	0	0	1018.3	1018.0	1017.8	1011.8
13	13.5	2.9	16.3	8.2	9.8	0.4	0	0	0.4	1009.3	1003.9	995.4	995.0
14	3.3	-0.4	3.3	1.2	[illegible]	0.4	1.2	1.2	1.6	995.7	997.6	1011.1	1019.5
15	4.0	-1.6	3.0	1.5	16.5	0	0	0	0	1022.2	1025.8	1026.8	1025.9
16	5.4	0.1	5.5	2.8	15.2	0	0	0	0	1028.1	1024.9	1023.1	1020.9
17	4.7	-4.2	4.5	2.3	15.7	0.8	1.4	1.4	1.6	1012.9	1017.6	1016.8	1011.4
18	1.2	-1.5	-0.3	-0.2	18.2	0	10.4	10.2	10.2	1008.3	1003.6	1001.7	1005.8
19	0.2	-1.7	-1.5	-0.9	18.9	0	0.6	0.6	0.6	1007.1	1008.6	1012.2	1014.8
20	-0.4	-4.1	-5.1	-2.6	20.6	0	1.0	1.0	1.0	1017.6	1019.8	1022.9	1024.8
21	-0.6	-4.8	-5.4	-2.7	20.7	0	0.8	0.8	0.8	1025.7	1025.9	1026.0	1025.3
22	-3.3	-5.1	-7.4	-3.2	21.7	0	1.0	0.6	0.6	1025.9	1025.5	1024.0	1025.1
23	-3.4	-5.2	-8.6	-4.3	22.3	0	0.8	0.8	0.8	1025.4	1026.4	1027.8	1029.3
24	0.7	-5.9	-5.2	-2.6	20.6	0	TR	TR	TR	1030.2	1030.9	1029.3	1020.1
25	6.6	-1.5	5.1	2.6	15.4	TR	0	0	TR	1019.9	1013.8	1007.8	1003.4
26	4.9	0.9	5.8	2.9	15.1	10.6	TR	TR	6.6	1001.0	993.0	993.0	1000.6
27	1.4	-7.6	-6.2	-3.1	21.1	0.2	1.6	1.6	1.8	1003.1	1010.4	1016.8	1017.6
28	-1.3	-7.3	-9.5	-4.3	22.3	0	0	0	0	1017.7	1017.8	1017.8	1018.1
29	-1.5	-5.8	-7.3	-3.7	21.7	TR	6.4	6.4	6.4	1016.3	1013.6	1007.4	1004.5
30	-1.8	-9.0	-10.9	-5.4	23.4	0 TR	TR	TR	TR	1014.6	1019.0	1024.6	1028.4
31	-0.2	-4.7	-4.9	-2.5	20.5	0.2	6.4	6.2	6.4	1029.5	1027.5	1028.1	1032.3
—	84.1	-75.1	[illegible]	[illegible]	[illegible]	37.4	46.6	45.8	[illegible]	31493.1	31458.1	31474.4	31517.5
—	2.7	-2.4	0.3	0.2						1015.9	1015.6	1016.0	1016.7

DATE	VAPOUR PRESSURE 00 GMT 15	06 GMT 16	12 GMT 17	18 GMT 18	STATION PRESSURE 00 GMT 19	06 GMT 20	12 GMT 21	18 GMT 22	DATE 23	DAYS WITH 24	25	26	27	28	29	30	31	32	PEAK WIND SPEED 33	34	35	NOTES: HOURS OF SUNSHINE
1	6.6	6.3	5.9	5.9	977.2	969.8	976.0	989.1	1							1			27	24	13	1.0
2	5.3	4.7	4.4	4.5	995.2	998.5	999.4	997.5	2										28	22	14	1.5
3	5.7	6.8	7.8	10.0	993.3	985.6	980.7	978.1	3										30	29	10	6.2
4	9.3	8.4	10.4	10.0	971.9	976.3	975.2	973.7	4										04	27	04	8.0
5	8.4	7.6	7.6	6.6	974.4	975.7	978.1	982.5	5										04	30	17	0.0
6	6.6	5.5	5.3	4.9	982.9	984.9	988.4	992.5	6										33	30	21	0.0
7	4.9	4.4	4.7	4.9	998.6	994.3	995.0	994.3	7										33	30	12	0.3
8	4.5	4.2	4.7	4.9	994.0	993.6	992.4	991.0	8													0.0
9	4.4	4.6	3.8	3.1	990.0	990.6	993.1	994.6	9										32	29	00	0.0
10	4.2	5.1	5.3	4.9	994.7	994.2	994.8	993.9	10										36	24	10	0.0
11	4.4	4.7	4.9	5.3	992.5	991.8	991.0	991.7	11													5.0
12	5.3	5.1	4.7	5.7	991.3	990.7	982.3	984.9	12										33	31	06	4.7
13	5.7	5.7	6.6	6.1	981.7	977.4	969.0	968.7	13										27	33	16	2.4
14	6.8	5.9	6.1	5.3	969.2	971.3	984.1	992.2	14								1		32	18	12	0.0
15	5.1	4.4	4.4	4.4	995.7	998.1	999.1	998.2	15													9.6
16	5.3	5.3	4.9	4.7	998.2	997.4	995.8	993.3	16													6.3
17	5.1	5.1	5.7	5.5	983.2	990.3	987.6	984.3	17										16	19	03	2.4
18	6.3	6.1	5.9	5.5	981.3	976.8	974.8	978.6	18										15	17	07	0.0
19	5.9	5.5	5.3	5.5	979.8	981.5	984.8	987.4	19													1.4
20	5.3	4.9	4.7	4.4	989.9	992.2	995.2	997.0	20										36	22	21	1.2
21	4.1	4.1	4.1	4.1	997.8	997.7	997.5	997.3	21													1.3
22	4.2	3.9	3.5	3.8	997.7	997.1	997.0	997.1	22													0.0
23	3.9	3.6	3.6	3.8	997.4	998.1	999.6	1001.0	23													0.0
24	3.6	3.6	4.2	4.7	1002.6	1002.5	1001.0	996.3	24										23	29	08	7.7
25	5.1	4.7	5.1	5.5	993.3	986.5	980.8	976.6	25										26	31	19	7.7
26	6.7	6.8	3.3	6.6	974.4	971.3	970.5	973.8	26										23	17	13	0.0
27	6.3	3.9	3.5	3.1	976.3	982.0	987.2	989.6	27		1								30	18	11	0.0
28	2.4	3.3	2.6	1.8	989.5	989.7	990.0	990.1	28		+								[illegible]	[illegible]	[illegible]	0→ 0.9
29	3.3	2.8	4.7	5.1	987.0	985.9	979.9	977.0	29		1								14	24	21	0.0
30	3.1	3.1	4.7	3.9	987.0	991.0	996.7	1000.0	30		1								35	21	10	0.7
31	4.2	4.7	5.5	5.1	1000.[illegible]	997.3	1000.1	1004.1	31		1								30	17	19	0.0
—	161.2	155.4	162.9	162.1	[illegible]	30532.9	[illegible]	[illegible]	—	0	4	0	0	0	0	1	1	0				
—	5.2	5.0	5.3	5.2	986.5	985.2	987.6	987.2	—													

CLIMATOLOGICAL MESSAGE

6180"1 441 8718-??0 DN
BIG TROUT LAKE

BLOCK AND INDEX	TEMPERATURE MEAN	TEMPERATURE HIGHEST	TEMPERATURE LOWEST	SNOWFALL	TOTAL PRECIPITATION	DEPTH OF SNOW ON GROUND	DAYS WITH 1.0 mm OR MORE PRECIPITATION	BRIGHT SUNSHINE	HEATING DEGREE DAYS	MEAN SEA LEVEL PRESSURE	MEAN VAPOUR PRESSURE	MEAN STATION PRESSURE

CALCULATION OF MEANS

	SEA LEVEL PRESSURE	VAPOUR PRESSURE	STATION PRESSURE
[illegible]	1015.9	5.2	985.5
[illegible]	1015.6	5.0	986.2
[illegible]	1016.0	5.3	988.6
[illegible]	1016.7	[illegible]	[illegible]

UHEDM

MONTHLY CLIMATOLOGICAL SUMMARY

STATION: BIG TROUT LAKE
PROVINCE: ONTARIO
MONTH: NOVEMBER
YEAR: 357

Date	Temperature 2	Temperature 3	Temperature 4	Temperature 5	°C 6	Precipitation 7	Precipitation 8	Precipitation 9	Precipitation 10	Sea Level Pressure 11 (00 GMT)	Sea Level Pressure 12 (06 GMT)	Sea Level Pressure 13 (12 GMT)	Sea Level Pressure 14 (18 GMT)	Vapour Pressure 15 (00 GMT)	Vapour Pressure 16 (06 GMT)	Vapour Pressure 17 (12 GMT)	Vapour Pressure 18 (18 GMT)	Station Pressure 19 (00 GMT)	Station Pressure 20 (06 GMT)	Station Pressure 21 (12 GMT)	Station Pressure 22 (18 GMT)	Date 23	Days With 24	Days With 25	Days With 26	Days With 27	Days With 28	Days With 29	Days With 30	Days With 31	Days With 32	Peak Wind Speed 33	Peak Wind Speed 34	Peak Wind Speed 35	Notes 36
1	2.7	-4.5	-1.8	-0.5	18.9	0	0.2	0.2	0.2	1035.1	1036.3	1030.1	1024.1	4.7	4.4	5.3	6.3	1007.0	1006.1	1003.2	996.4	1										8	25	06	32
2	4.5	-1.4	5.1	1.6	16.4	[illegible]	[illegible]	TR	5.2	1017.4	1022.2	1011.0	1014.5	6.6	7.1	7.5	6.1	990.1	955.1	984.0	987.1	2										35	20	21	0.0
3	2.4	-1.5	0.5	0.5	17.5	0.2	TR	TR	0.2	1014.5	1011.4	1004.9	1000.2	5.1	5.1	6.6	6.1	975.4	984.1	977.7	973.3	3													0.6
4	1.8	-9.1	-2.3	-3.7	21.7	0.1	1.0	1.0	1.1	997.3	995.7 ~~[illegible]~~	1003.0 ~~[illegible]~~	1010.5 ~~[illegible]~~	6.3	6.3	3.3	2.4	970.5	969.0 ~~[illegible]~~	976.8 ~~1000.0~~	982.7 ~~1010.5~~	4							1	1		31	37	16	0.8
5	-4.7	-7.9	-12.6	-6.3	24.3	0	TR	TR	TR	1017.1 ~~[illegible]~~	1014.4	1015.6	1017.6	2.8	2.6	2.5	2.8	984.2 ~~[illegible]~~	986.2	987.5	989.4	5										30	34	09	2.4
6	-5.4	-10.8	-6.2	-8.1	26.1	0	0	0	0	1016.6	1015.1	1017.9	1011.7	2.3	2.0	2.4	1.9	988.4	986.9	984.7	983.5	6										24	32	02	8.6
7	-6.5	-16.5	-17.6	-5.5	24.5	0	TR	TR	TR	1014.5	1011.7	1012.4	1016.4	2.5	2.0	2.4	2.2	981.3	981.7	984.2	981.9	7										28	25	11	7.9
8	-8.1	-11.0	-14.7	-9.1	27.9	0	0.6	0.6	0.6	1018.5	1020.7	1023.1	1024.0	1.8	2.3	2.4	3.1	990.1	991.9	993.4	995.3	8										30	26	14	0.0
9	-1.6	-12.4	-20.0	-10.0	28.0	0	TR	TR	TR	1035.7	1038.6	1031.0	1034.1	1.9	2.4	2.6	2.0	997.0	999.4	1001.2	1005.0	9										30	26	07	2.7
10	-0.1	-12.6	-12.7	-6.4	[illegible]	0	0	0	0	1035.3	1033.2	1025.7	1015.9	1.8	2.3	3.3	4.4	1005.3	1004.1	997.4	987.2	10										19	24	23	1.3
11	1.6	-4.8	-3.2	-1.6	15.6	TR	11.2	10.5	10.5	1003.1	1005.8	1011.2	1014.4	4.7	6.1	5.5	4.1	979.7	976.6	983.9	981.5	11										36	27	05	0.0
12	0.5	-5.0	-4.2	-2.1	20.1	0.2	TR	TR	0.2	1012.2	1007.5	1001.0	1000.8	3.6	4.1	5.5	6.1	984.1	975.9	973.7	973.6	12										30	18	07	0.0
13	1.6	-5.1	-4.0	-2.1	20.1	0.4	1.0	0.5	1.1	1001.7	1003.6	1007.6	1012.2	6.1	4.7	3.8	4.1	974.6	975.5	980.2	984.6	13										31	23	15	0.0
14	-3.1	-6.6	-9.7	-4.9	21.9	TS	0.4	0.4	0.4	1015.2	1015.3	1022.2	1023.7	4.2	3.6	4.2	4.2	987.9	991.3	994.2	996.6	14		1											0.0
15	3.3	-5.2	-2.9	-1.5	19.4	4.2	TR	TR	4.2	1023.4	1020.6	1017.6	1012.4	3.6	3.4	5.3	5.9	995.4	992.6	989.4	985.3	15		1								15	21	14	0.1
16	3.1	-7.0	-1.7	-1.0	19.2	1.2	0.3	0.3	1.4	1009.0	1014.1	1018.6	1012.1	3.1	3.3	5.3	4.1	982.6	983.0	983.4	984.0	16										26	17	04	0.0
17	-3.6	-15.1	-19.5	-9.8	27.8	0	0.2	0.2	0.2	1013.6	1012.3	1013.3	1013.0	3.9	3.9	2.3	1.6	985.0	985.0	985.3	984.0	17										33	21	14	6.4
18	-1.7	-16.9	-22.1	-11.1	29.1	0	10.6	6.6	6.6	1013.4	1011.0	1005.4	1004.2	1.4	1.9	2.2	3.0	984.7	976.1	977.1	971.8	18							1			23	12	14	0.0
19	-13.4	-22.1	-32.5	-16.3	34.3	0	0.2	0.3	0.3	1011.0	1013.4	1012.1	1019.7	1.3	1.2	1.1	1.3	983.9	985.5	993.0	995.6	19							1			31	31	04	2.7
20	-19.3	-21.4	-26.7	-10.5	36.5	0	TR	TR	TR	1017.2	1022.6	1025.7	1026.5	1.2	0.9	1.2	1.3	993.6	992.9	996.1	996.8	20							1			30	26	12	8.0
21	-5.8	-19.1	-24.9	-12.9	30.9	0	0.9	0.4	0.9	1023.8	1019.9	1013.6	1009.3	1.3	1.3	1.8	3.0	994.2	990.4	984.6	979.6	21							1			5	34	00	0.0
22	-5.4	-12.5	-14.1	-9.1	26.1	0	TR	TR	TR	1006.1	1008.7	1009.9	1009.1	3.6	3.5	3.0	4.1	978.6	978.8	980.1	981.4	22										34	20	04	1.2
23	-14.9	-10.1	-28.0	-14.0	32.0	0	TR	TR	TR	1013.5	1015.7	1019.8	1023.7	1.8	1.7	1.8	1.6	985.2	987.4	990.3	994.6	23										33	19	13	0.6
24	-10.0	-18.5	-28.9	-14.5	32.5	0	TR	TR	TR	1027.6	1031.2	1034.6	1034.9	1.6	1.4	1.8	1.0	998.2	1001.5	1005.1	1005.5	24										17	17	06	3.8
25	-5.8	-10.8	-16.6	-8.4	26.4	0	0	0	0	1033.7	1031.5	1033.6	1032.4	2.2	2.4	2.6	2.0	1004.5	1004.5	1003.3	1003.4	25										20	21	08	7.3
26	-0.9	-7.8	-8.7	-4.4	22.4	TR	0.6	0.6	0.6	1030.4	1028.9	1026.3	1025.4	3.1	3.3	4.1	4.9	1001.9	1000.3	997.9	997.4	26		1								14	20	12	0.2 0.0
27	-0.6	-2.3	-2.0	-1.4	19.4	TR	0.4	0.4	0.4	1025.5	1023.1	1023.0	1025.4	5.3	5.1	4.9	4.7	997.6	999.3	995.2	997.6	27		1								21	24	04	0.0
28	0.3	-4.5	-4.2	-2.1	20.1	0	TR	TR	TR	1024.9	1020.4	1019.1	1018.3	4.2	4.2	4.5	4.2	995.1	992.6	991.4	990.5	28										19	21	07	8.1
29	-1.5	-9.2	-10.7	-5.4	23.4	TR	TR	TR	TR	1016.6	1016.5	1017.2	1018.9	4.9	5.3	4.9	3.2	988.9	988.8	989.5	991.0	29		1		1						34	17	21	0.0
30	-8.6	-13.5	-21.1	-10.6	28.6	TR	2.6	0.4	0.4	1019.8	1019.7	1019.6	1019.3	2.6	2.9	2.4	2.3	991.7	991.4	991.1	990.8	30		1											0.0
31	—	—	—	—			—	—	—	—	—	—	—									31													
—	[illegible]	[illegible]			742.6	11.3	30	28.6	34.9	[illegible]	[illegible]	[illegible]	[illegible]	104	[illegible]	107.5	104.6	[illegible]	[illegible]	[illegible]	[illegible]	—													
—	-5.3	-10.1	-13.4	-6.7	.		.	.	.	1017.3	1017.3	1017.1	1017.2	3.5	3.5	3.6	3.5	989.2	989.1	989.9	989.1	—													

CLIMATOLOGICAL MESSAGE

048071 601 0730-250 OH

BIG TROUT LAKE
NOVEMBER , 1967

TEMPERATURE MEAN	TEMPERATURE HIGHEST	TEMPERATURE LOWEST	SNOWFALL	TOTAL PRECIPITATION	DEPTH OF SNOW ON GROUND	DAYS WITH 1.0 mm OR MORE PRECIPITATION	BRIGHT SUNSHINE	HEATING DEGREE DAYS	MEAN SEA LEVEL PRESSURE	MEAN VAPOUR PRESSURE	MEAN STATION PRESSURE

CALCULATION OF MEANS

	Sea Level Pressure	Vapour Pressure	Station Pressure
[illegible]	1017.3	3.5	989.2
[illegible]	1017.3	3.5	989.1
[illegible]	1017.1	3.6	989.9
[illegible]	1017.2	3.5	989.1
—	4068.9	14.0	3956.3

APPENDIX E 1

Summary Of Wood Consumption As Monitored

October 25, 1987

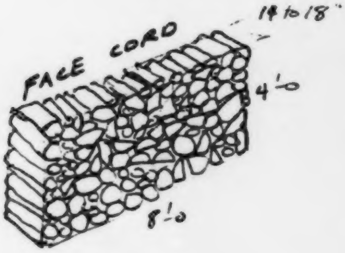
1.	Susan Bird	House	7	
2.	Alfred Metat	"	6	
3.	Mike Wabano	"	22	
4.	Priest House	"	23	
5.	Antoine Gull	"	77	
6.	Luke Gull	"	80	(uncooperative)
7.	Dorothy Hunter	"	31	
8.	Daniel Koostachin	"	79	

Father Gilles House

1@4' x 8' x 14" average = 650lbs. to a cord.

Other homes wood size averages 18" long.

FACE
14" cord = 650 lb.
16" cord = 743 lb.
18" cord = 836 lb.



APPENDIX E 2

House # 7 - Susie Bird

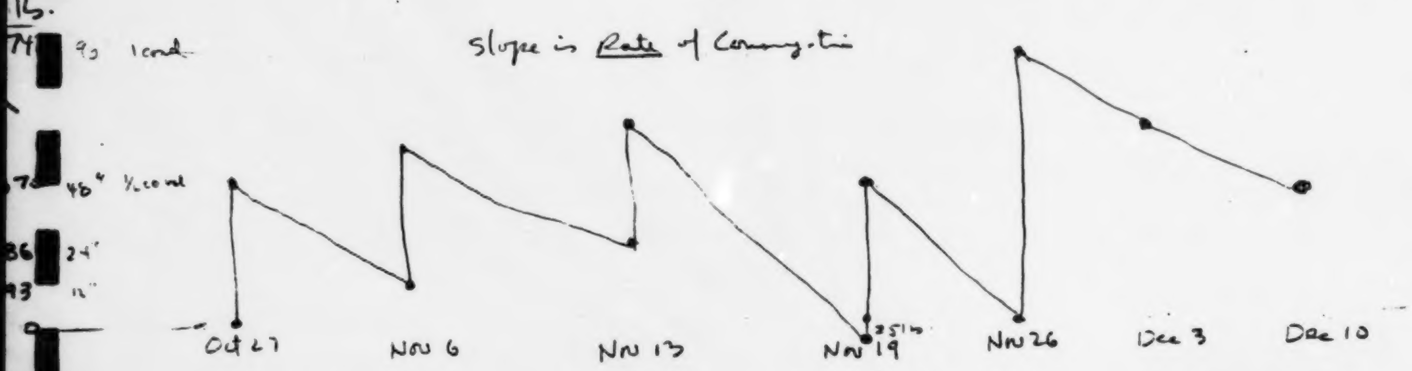
CHATELAINE

Oct. 27/87 - Half Cord = 48" x 48" x 16" 370 lb.
Checked - Nov. 5 - 48" x 12" x 16" left over (93 lb.) left over
Nov. 6 - Second half cord - 48" x 48" x 16" + 370 lb.
Checked Nov. 12 - 48" x 24" x 16" left over (186 lb) left over
Nov. 13 - Third half cord - 48" x 48" x 16" 370 lb.

Nov. 19 - All burned plus 25 lbs 25 lb. 0
Nov. 19 - Fourth 48" x 48" x 16" 370
Nov. 26 - All burned 5th full cord 48" x 96" x 16" 743 0
Dec. 3 - Burned half of 4' x 4' x 16"
Dec. 3 - 3/4 of cord 4' x 4' x 16" left

Dec. 10 - Burned 1/4 - Dec. 10 1/2 cord still to burn

Slope is Rate of Consumption



Days	10 days	7	6	7	7	8
Daily Consumptn -	277 lb	279	582	370	186	186
otal Avg Daily Consumptn -	27.7 lb/day	39.8 lb/day	97 lb/day 4 lb/hr	52.8	26.6	23.2 lb/day 1 lb/hr.

Fuel (wood) Consumption.

Re/day

see if it corresponds to
indoor & outdoor temperatures?

AVERAGE WOOD CONSUMPTION = 41.77 lb/day
= 18.95 Kg/day

APPENDIX E 3

House # 6 - Alfred Metat

STOVE
LAKEWOOD COTTAGER

9 days	Oct. 27/87	- First 35" x 24" x 14"	650 × 35/96 × 24/48 = 118.5 lb.	178.5
	Nov. 5	- All burned plus 60 lbs.		
7	Nov. 5	- Second cord - 36" x 24" x 14"		118.5
	Nov. 12	- All burned		
5	Nov. 12	- Third cord - 36" x 24" x 14"		118.5
5	Nov. 17	- All burned - Fourth cord 36" x 24" x 14".		118.5
5	Nov. 22	- Fifth - 36" x 24" x 14"		118.5
	Nov. 27	- Sixth 36" x 24" x 14"		118.5
8	Dec. 3	- Out of town (hunting)		118.5
	Dec. 5	- Back home - seventh cord		118.5
5	Dec. 10	- Checked still half - 36" x 24" x 14"		59.25
44 days				948.25 lb.

AVERAGE WOOD CONSUMPTION: 21.5 lb/day
= 9.8 Kg/day

NOTE: IN ALL CASES, TEMPERATURE GRAPH IS MUCH SMOOTHER IN NOV. 87 THAN MAR. 87. THIS SHOWS PEOPLE HAVE LEARNED HOW TO CONTROL THE STOVES BETTER AFTER A FEW MONTH'S EXPERIENCE.

APPENDIX E 4

House # 22 - Mary Jane Stoney (Mike Wabano) - STOVE SELKIRK RANGER

Oct. 22/87	- First half cord = 48" x 48" x 16"
Nov. 5	- Approx. 45 lbs left to burn
Nov. 6	- Second half cord - 48" x 48" x 16"
Nov. 12	- 50 lbs to go
Nov. 13	- Third 1/2 cord 48" x 48" x 16"
Nov. 19	- All burned - Fourth cord 48" x 48" x 16"
Nov. 26	- Fifth cord 48" x 48" x 16" + 40-50 lbs.
Dec. 3	- Sixth half cord 48" x 48" x 16"
Dec. 10	- No one home

AVERAGE WOOD CONSUMPTION = 41.0 lb/day

= 18.6 Kg/day

APPENDIX E 5

House # 23 - Father Gilles

Cord 14" - 325lbs.

Oct. 26/87 - First half cord 48" x 48" x 14
Nov. 5 - Checked - all burned
Nov. 5 - Second half cord
Nov. 11 - Third half cord

Nov. 20 - Fourth 48" x 48" x 13 cord
Nov. 26 - All burned - (new) 48" x 48" x 13 cord
Dec. 3 - 60 - 70 lbs left to burn
Dec. 3 - Sixth 48" x 48" x 13 cord

Dec. 10 - 16" left to burn
Dec. 11 - 1/2 cord 4' x 4' x 14"

AVERAGE WOOD CONSUMPTION = 39.7 lb/day
= 18.0 Kg/day

APPENDIX E 6

STOVE

House # 31 - Dorothy Hunter - HERITAGE CARTIER 1

DAYS

6 Oct. 30/87 - Wood box size 48" x 24" x 14" = 162.5 lbs

Nov. 5 - Burned twice the size - 96" x ~~48"~~ 24 x 14" = 325 lb

Nov. 5 - Second cord 48' x 24" x 14" = 162.5 lb.

7 Nov. 12 - Burned 96" x ~~48"~~ 24 x 14" 325 lb.

Nov. 12 - Thired cord 48" x 24" x 14" 162.5 lb.

7

Nov. 19 - Burned 96" x ~~48"~~ 24 x 14" - Fourth 48" x 24" x 14"

7 Nov. 26 - Burned 48" x 24" x 14" - Fifth 48" x 24" x 14"

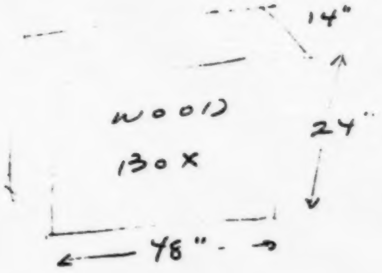
7 Dec. 3 - Burned 48" x 24" x 14" plus 50 lbs more

Dec. 3 - Sixth 48" x 24" x 14"

7

Dec. 10 - All burned

Dec. 10 - 1/2 cord - 48" x 24" x 14" 1512.5 lb.



AVERAGE WOOD CONSUMPTION = 36.89 lb/day

= 16.73 Kg/day.

APPENDIX E 7

House # 77 - Antoine Gull

STOVE
SELKIRK RANGER

10 days Oct. 26/87 - First wood pile - 89" x 33" x 16" 743 × $\frac{89}{96}$ × $\frac{33}{48}$ = 473 } 403 lb.
Nov. 5 - Checked - 70lbs left to burn
Nov. 7 - Second cord - 89"x 33" x 16"
10 days Nov. 12 - Checked - 48" x 24" x 16" - some left to burn 473 lb.

Nov. 17 - All burned
7 Nov. 17 - Third - 89" x 33" x 16" 473 lb } 473 lb.
Nov. 24 - All burned
3 Nov. 24 - Fourth - 89" x 33" x 16" 473 lb.
Nov. 27 - Burned about 89" x 12" x 16"
6 Dec. 3 - Fifth - 89" x 33" x 16" - more to burn 473
7
Dec. 10 - All burned
Dec. 10 - Sixth cord - 89" x 33" x 16"

43 days 2295 lb.

AVERAGE WOOD CONSUMPTION: 53.4 lb/day

= 24.2 Kg/day

APPENDIX E 8

House # 79 - Daniel Koostachin

STOVE
HERITAGE CARTIER 1

FACE
1 CORD = 696 lb
= 315.9 Kg

DAYS			
	Oct. 28/87	- Wood box - 48" x 24" x 15" (1/4 FACE CORD)	348 lb
8	Nov. 5	- Burned twice the size	
6	Nov. 5	- Second - 48" x 24" x 15"	244 lb.
	Nov. 11	- All burned plus about 70 lbs.	
8			348 lb
	Nov. 19	- Burned 48" x 48" x 15" - Fourth 48" x 24" x 15"	
7.	Nov. 26	- Burned 48" x 48" x 15" - Fifth 48" x 24" x 15"	348 lb
7	Dec. 3	- Fifth cord burned plus 40-50 lbs.	214 lb
	Dec. 3	- Sixth 48" x 24" x 15"	174 lb
7			
	Dec. 10	- All burned - 48" x 24" x 15"	
	Dec. 10	- Seventh cord - 48" x 24" x 15"	
44 DAYS			1676 lb

AVERAGE WOOD CONSUMPTION = 38 lb / day
= 17.3 Kg /day